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Years of Endeavour

The Council of Ironfoundry Associations have just issued a very readable illustrated pamphlet carrying the above title. It is a record of the improvements which the industry has largely imposed upon itself during the last seven years. There are four sections, the first of which is called "A Difficult Inheritance." Yet we remember when the Factory Department issued regulations governing the "grinding of metals," there was some outcry amongst foundry owners against our editorial view that such rules were necessary and desirable. A year or so later, one of the grumblers confessed that the reorganization of the fettling shop had been accompanied by lowered operational costs. That, and other sensible Factory Acts, undoubtedly influenced the minds of foundry owners, though when envisaging the provision of bathing facilities, founders have been unable to see how they could reflect favourably in the balance sheet. Still, good results may eventuate as a result of the attraction and retention of the better type of workmen. Efforts made in the direction of accident prevention, such as the provision of goggles, safety boots, and the like, will not exactly pay dividends but will reduce the heavy losses, direct and indirect, caused through injuries to the staff.

The second section covers what is popularly referred to as the "Garrett Report." In a conversation with the late Mr. T. Makemson, he claimed that it was on his advice, when he was director of iron castings, that the original committee was set up to make recommendations for improvements in the working conditions of iron foundries. What is more important than the original idea, is the zest with which the principles enunciated were taken up by the industry, and this section and the one which follows—"The Factory Department's Testimony"—afford ample evidence of the great voluntary effort made. The pages of the JOURNAL of this period carry many illustrated descriptions of the bathing and washing facilities then being installed. With the passage of time, the reluctance of a section of the men to use the facilities provided has been largely overcome.

The final chapter, "Progress to be Continued," does not include a clarion call to the industry, but plainly states that there is a consciousness of their responsibility amongst foundry owners, which is better than a mass of legislation. There was a Bill before the House to make all the "Garrett Report" recommendations legal; however, a compromise was reached by introduction of the "Iron and Steel Foundries Regulations" as part of the factory law. This was a better policy, for, just as a modern motor-car factory and a country shoeing smithy are components of engineering activities, so, too, the great pipe foundries and the smallest jobbing shop enter the make-up of the foundry industry. Legislation appropriate to the former is bordering on the ridiculous for the latter. Whilst this booklet tells but little that is new to the ironfounder, it should help sections of the popular daily Press, the stockbroker, and the man in the street to have a better appreciation of what an iron foundry is like and help to eradicate some of the uninformed and harmful criticism our industry encounters from time to time. For this purpose, we feel the publication should do much good.

G

RICHARD MILES

Chairman and Managing Director, Head, Wrightson & Company, Limited.

Leaders of the Industry

RICHARD MILES

THE Miles family have been well known in the foundry trade for five generations, successively at Tredegar Coal & Iron, Staveley, Stanton (Holwell), Newton Chambers, and Head Wrightson's. Richard Miles' apprenticeship was served in Germany, and at Newton, Chambers' ironworks, of which he eventually became general manager, leaving in 1932 to join Head, Wrightson & Company, Limited, of which he is now chairman and managing director.

He read mechanical engineering at Sheffield University, graduating in 1914. His interests were wide, as he played Rugby football, hockey, and lawn tennis for the University; was a member of the students' representative council; secretary of the Engineering and Metallurgical Society; and a sergeant in the O.T.C. He was commissioned in August, 1914, in the K.O.Y.L.I., later transferring to the Machine Gun Corps, and served in France and Palestine.

The same wide interests have marked Mr. Miles' professional career, due perhaps to the very varying nature of the activities for which he has been responsible. He has served on literally dozens of technical, trade-association, academic and other committees. He was president of the Institute of British Foundrymen for two years, 1941-42; is a member of the Institute of Mechanical Engineers; and a Fellow of the Institute of Industrial Administration; he has contributed to the national and other Press on technical and industrial economic subjects.

During the last war, he was responsible for a considerably expanded production of defence material, much of it based on steel castings, and was appointed by the Ministry of Supply to direct other undertakings. Amongst these was the rehabilitation of two derelict shipyards, where large numbers of pre-fabricated ships were built and launched on mass-production lines.

Mr. Miles holds progressive views on co-operation in industrial and allied affairs and has given much time to its development in many directions. Export, and activities in the Dominions, have demanded many visits abroad recently, especially to South Africa, Australia and the U.S.A.

He has a son and daughter, both following academic careers. His relaxations now, he says, are just " pottering about " on the golf course, in the garden, and on the piano; and listening to Beethoven.

John Bell Travelling Scholarship

On Friday, October 22, at a meeting in the Royal Technical College, Glasgow, Mr. John Bell, president of the Institute of British Foundrymen, handed to Sir Andrew McCance (on behalf of the Governors of the College), a cheque for £1,700 to constitute the "John Bell" travelling scholarship. This sum is the balance in hand after meeting all the expenses of the conference of the Institute held in Glasgow in June, 1954. The conference executive, after consultation with subscribers to the fund, decided to constitute the award in recognition of the work done by Mr. Bell during 31 years of office as honorary secretary of the Scottish branch of the Institute.

The Scholarship will be a post-graduate scholarship and will be awarded annually to the successful student in the metallurgical course of the College, who, however, must be of Scottish birth and parentage, or have resided for not less than three years in Scotland. He should also have served in, or intend to serve in, the foundry industry.

At the meeting, the Institute was represented by Mr. Bell, president, Mr. D. Brown, Scottish branch president, Mr. Ronald Taylor, convener of the Scottish conference executive and Mr. A. Marshall, honorary conference secretary, who is also honorary secretary of the Scottish branch. Subscribers to the fund were represented by Mr. Henry Gardner, (Glenfield & Kennedy, Limited), and Mr. G. M. Menzies, (North British Steel Foundry, Limited), both members of the Institute. The Technical College was represented by Sir Andrew McCance, D.SC., F.R.S., chairman of the Governors, A. Turnbull, C.B.E., J.P., deputy chairman of the Governors, Dr. D. S. Anderson, B.SC., PH.D., A.R.T.C., M.I.MECH.E., director, Dr. R. Hay, B.SC., PH.D., F.R.I.C., F.I.M., Professor of Metallurgy, and G. H. Thomson, B.COM., A.L.A.A., secretary.

Correspondence

CO_2 PROCESS

To the Editor of the FOUNDRY TRADE JOURNAL

SIR,—The following may be of interest to foundrymen who are investigating the possibilities of the CO_2 process. While carrying out some experimental work on this process, we experienced the difficulty, believed to be not uncommon, that lack of breakdown after casting made the removal of cores extremely difficult. We have found that the addition of about 2 per cent. of calcium fluoride to the mixture, while not apparently affecting the hardening of the core, gives a breakdown after casting comparable with that of a normal oil-sand core.

Further investigations will probably disclose an optimum figure for this addition, or any objection to its use, but in the meantime we pass on the information for what it is worth. We should be very pleased to hear if any firms have had any experience along these lines.—Yours, etc.,

A. N. WRIGHTSON.
W. B. HENDRY.
W. PRENTICE.

National Foundry College,
Stafford Street, Wolverhampton.
October 25, 1954.

SIX LECTURES on the marketing of iron and steel and related problems are to be given at the Sheffield College of Commerce and Technology during the winter.

Die-casting Exhibition

As two-thirds of the British zinc die-casting industry is in the Birmingham area, and a large proportion of its products are used in the Midlands, Birmingham was selected as the centre for an exhibition of some 500 varied zinc-alloy die-castings which was opened at the Birmingham Exchange and Engineering Centre on October 25, arranged by the Zinc Alloy Die Casters' Association. Its opening was timed to coincide with the opening at Westminster Hall, London, of the first international pressure-die-casting conference. On October 28, delegates from the London conference visited the Midlands to see the exhibition and to visit factories.

At the Birmingham exhibition, innumerable applications of zinc-alloy die-castings are illustrated, ranging from industrial applications for the automobile, cycle and light and heavy-engineering trades, to household applications. Even a small crucifix is exhibited. This type of die-casting is meeting with a constantly increasing variety of uses which the exhibition exemplifies. The sharp definition of zinc-alloy die-castings enables complex shapes to be cast accurately, and the ease with which the metal can be plated is an additional reason for its increasing popularity. Long life is another advantage claimed for zinc-alloy casting dies; each die, it is claimed, lasts for up to 1,000,000 castings.

Production Details

In the motor-trade zinc-alloy die-castings are used for such parts as carburettors, petrol pumps, shock absorbers, radiator grilles, and steering columns. Owing to their precision, they are increasingly being used in the intricate small castings required in scale-model toys. Their use in trolley wheels, office machines, television aerials, washing machines, sewing machines, gramophones, water-tap nuts, fanlights, and in manifold other applications is demonstrated in the Birmingham exhibition.

British production during the first eight months of this year was running at the rate of 33,000 tons a year, which is considerably higher than the average for the previous three years. Britain's consumption of zinc-alloy castings per head of the population is at least three times as great as that of any European country, although American consumption is three times greater than ours.

British production is allocated thus—cars and cycles 68, electrical industries 15, home appliances and light engineering 5, toys 3, heavy engineering 6 and other uses 3 per cent. The Birmingham exhibition will remain open until Saturday evening.

Cocktail Party—J. E. V. Jobson

Mr. J. E. V. Jobson was host at a cocktail party held on October 27 at the Dorchester Hotel. Many prominent members of the foundry industry were present.

Dinner—Mr. Frank Webster

Mr. Frank Webster, president of the Foundry Trades Equipment and Supplies Association, entertained members of the Council on Wednesday of last week at Grosvenor House Hotel.

AT LAST THURSDAY'S meeting of the Foundry Trades Equipment and Supplies Association, Mr. G. E. Lunt (Bradley & Foster, Limited) was elected vice-president.

British Cast Iron Research Association

Annual Report for 1953-54

The annual report of the Council of the British Cast Iron Research Association, for the period July 1, 1953, to July 1, 1954, has recently been issued and was presented at the annual general meeting on November 3 in the following terms:—

The Council is gratified to record the honour of knighthood conferred in June, 1954, on the president, Sir Frederick Scopes, who is also president of the Joint Iron Council. Losses by death have been serious and include Mr. P. H. Wilson, O.B.E., M.I.MECH.E., past-president of the Association and for many years an active participant in its affairs; Mr. H. B. Weeks, who was a member of Council for over 20 years from 1921 to 1943 and its chairman until 1937; and Mr. T. Makemson, M.B.E., member of Council, who had been secretary of the Institute of British Foundrymen since 1926. Mr. N. R. Rees has retired from the Council following his retirement from the service of the Staveley Iron & Chemical Company, Limited.

At the annual meeting held on November 4, 1953, the president, Sir Frederick Scopes, was re-elected, together with the vice-presidents. The Council re-elected Mr. J. J. Sheehan, B.SC., A.R.C.SC.I. as chairman and during the year has held five meetings, together with eleven meetings of the Council's advisory committee. Mr. E. P. Major was re-elected honorary treasurer. The main committees of the Council (Research Board and Research Committee, chairman, Mr. A. E. Peace; Development, chairman, Mr. J. J. Sheehan; Information, chairman, Mr. R. L. Handley; Operational Research, chairman, Mr. A. Watson; Foundry Atmospheres, chairman, Mr. C. Gresty; Scottish Committee, chairman, Mr. J. Arnott) held twenty-three meetings in all. The research sub-committees and panels held sixteen meetings, making a total of fifty-five meetings during the year under review.

Reference was made in the last report to the extension by the Department of Scientific and Industrial Research of the grant period ending June 30, 1953, by one year, until June 30, 1954, and to the reasons for the Association's request for this extension. During the year under review the Association prepared an application for grant for the period 1954-59, covering both income and capital requirements for this period, and the Council nominated a deputation to attend the Department of Scientific and Industrial Research. The deputation, which met the industrial grants committee of the D.S.I.R. Advisory Council on April 7, 1954, was cordially received, and the application received a very full discussion; as a result, the Department offered (for the five-year period commencing July 1, 1954) to maintain the existing maximum grant of £40,000 subject to the receipt of a minimum industrial income of £100,000, plus a supplementary grant of £80 for each £100 of additional industrial income up to a limit of £16,000, to earn which an additional £20,000 would be required. The Council approved and officially accepted these proposals, and considerable progress has been achieved to conclude arrangements whereby the industrial income may be assured. Subject to compliance with the stipulated minimum, the Association's income will therefore be £140,000 per annum, with a potential maximum of £176,000.

The "open days" (held at intervals of two years) were arranged for July 7 and 8, 1954. On the first of these some 300 representatives of member-firms attended and were welcomed by the president, Sir Frederick Scopes, who said that a special effort had been made by the staff to explain the work that they were doing by means of charts, figures, photographs, working models and demonstrations. On the second day, some 170 representatives of other research organizations, Government departments and laboratories, trade associations, technical institutions, universities, technical colleges and schools attended, and were welcomed by the chairman of Council, Mr. J. J. Sheehan. In addition to the usual displays of technical and scientific interest, a small exhibit of some 90 pieces of iron castings of an artistic character were shown, of oriental, German and British workmanship. In a special catalogue of these pieces prepared by the director, reference was made to the value of preserving the skills employed in such castings, illustrated by the adoption of the mediaeval lost-wax process for certain types of castings involved in special developments during the war. It was obvious from the comments made not only that the exhibit gave a great deal of pleasure, but that the large majority of visitors were quite unaware of the possibilities of cast iron as an artistic medium.

Sir Lincoln Evans, member of Council and vice-chairman of the Iron and Steel Board, was prevented from attending on July 7, but arranged a special visit to Alvechurch on July 16 and made a tour of the laboratories.

Conditional Aid

Reference was made in the last report to the application made by the Association for part of certain funds made available through the Mutual Security Agency, and known as Conditional Aid. One of the conditions laid down was that while the funds should be applied to new works, they could not be used for scientific and technological research in the usual sense, but mainly to promote activities relating to productivity. The activities chosen for assistance fall into three categories: foundry practice, health and safety, and full economy.

In connection with productivity in its more direct sense, four items were selected:—

(*a*) Mechanical moulding by moulding machines, sand-throwing and sand-slinging methods, and the development of their use in

jobbing foundries, especially small and medium-size foundries.

(*b*) Simplification and standardization of runners and runner gates, with a view to the production of sound castings with a minimum use of molten metal.

(*c*) The development of green-sand moulding, or skin-dried moulds, as an alternative to stove-dried (dry-sand) moulding.

(*d*) The production of good quality patterns to simplify and improve foundry practice and economize on moulding costs.

In view of the new Statutory Regulations concerning iron foundries which (apart from certain deferred clauses) came into force on January 1, 1954, the Council decided to provide members with an advisory service on points arising from these regulations, particularly with reference to dust and fume.

It was also decided to establish an advisory service on fuel economy in foundries with special reference to:—

(*a*) The adoption of the hot-blast cupola, and the influence on this economy of further developments such as the water-cooling of basic linings.

(*b*) Improvement in the design and operation of existing cold-blast cupola furnaces in relation to the fuel used and metal produced.

(*c*) Economy in the use of fuel for other purposes than melting, particularly in mould and core ovens, sand dryers, ladle dryers, malleable annealing ovens and heat-treatment furnaces.

(*d*) The influence on fuel economy of the Statutory Regulations mentioned above, which have already called for the abolition of open fires for foundry heating and for mould and ladle drying.

Staff appointments have been made in connection with these developments, which were put into operation as from January 1, 1954. Member-firms have been advised of these services by circular and considerable interest has been displayed. The staff has since been busily engaged in each of these sections and a fuller statement will be made in the next Report. The activities concerned will cover a period of three years from the date indicated by the terms of Conditional Aid, that is, to the end of 1956.

Continental Visit

In May, the Association resumed for the first time since the war the practice of arranging visits for groups of members to Continental foundries of special technical interest, a practice which dates back to 1925. Two parties, totalling nearly 60 representatives from member-firms, visited 10 foundries in Belgium and Germany, each party during a period of a working week. The main object of the tour was to inspect foundries with hot-blast cupola installations, and with one exception every available commercial type was seen. The visit was described in the *Bulletin* for May, 1954; the volume of opinion expressed by the participants shows clearly that they agreed that such visits served a very useful purpose, and they were impressed by the warmth of their reception and the hospitality they received. The thanks of the Association are due to the firms concerned. On the last evening of visit of the second party a dinner of welcome was offered by the *Verein Deutsche Giessereifachleute*, the president of which, Mr. W. Kuster, took the Chair; representatives of German firms, technical and scientific societies, trade associations and universities were present.

Research Department

The Research Board and Research Committee are responsible for reviewing the research programme, assisted by a number of sub-committees which together cover all branches of the industry and its major technical activities: these are the engineering castings, light castings, malleable castings, white and chilled castings, methods of analysis, sands and refractories, and fuels and furnaces sub-committees.

Gases in Cast Iron

The application of the vacuum-heating method for the determination of hydrogen in cast iron has been studied and suitable apparatus has been constructed. The hydrogen is estimated by measuring the change in pressure on one side of a palladium thimble. This enables the rate of hydrogen evolution to be investigated. Results show that hydrogen is rapidly evolved just below and well above the critical temperature range. The evolution of hydrogen is more rapid with white irons than with grey irons and appears to be incomplete in the latter case. The most rapid extraction of hydrogen is obtained with cylindrical samples with an axial hole. Apparatus has been developed for a study of the evolution of hydrogen at room temperature. Hydrogen is evolved continuously over periods up to at least 200 days.

The influence of oxygen on carbide stability has been studied and found to have no direct effect. Oxygen has an apparent carbide-stabilizing effect when it combines with elements such as aluminium, which have a graphitizing influence. Theoretical aspects of oxygen in cast iron have been reviewed. Field tests to determine the gaseous element content of irons produced in various foundries have continued. The partitioning of nitrogen between elements such as aluminium and titanium, etc., and iron, has been studied by measuring the acid-insoluble and the acid-soluble fractions during the chemical determination of nitrogen. Neutralization of the effects of nitrogen by aluminium and titanium appears to take place by the formation of acid-insoluble nitrides. This is not so in the case of boron. The neutralization of titanium by nitrogen in nodular cast iron has also been studied.

Moulding Sands

Using an apparatus which can determine stress/strain curves on compression test-pieces at room and at elevated temperatures, the influence of clays on the properties of sand at high temperatures has been studied.

Apparatus to produce shell-moulding test-pieces has been constructed and work has been carried out on the effects of resin percentage, sand grain-size and type, and on the influence of clay content, curing temperature, curing time, gas content and breakdown.

An investigation into the effects of burnt or "dead" clay on the properties of moulding sand has been carried out for various clays used with synthetic and also natural sands. The influence of grain-size distribution on some properties of sand has been studied. A method of computing the average distance between adjoining sand grains has been developed and used to study the effect of grain-size distribution on permeability, metal penetration and thermal conductivity.

An investigation has been completed on the influence of sand type, ramming and moisture content on surface finish.

The instructional courses on sands have been continued as required, and some 240 have attended, to August, 1954. Each course occupies four days and during this time a group of twelve students is advised and instructed on sand testing and control.

Dephosphorization

A preliminary survey has been made of the problems involved in reducing or removing the high-phosphorus content of British pig-irons. The mode of occurrence of phosphorus in British ores was studied and a critical examination made of the iron-producing processes in order to evaluate the possibility of phosphorus removal or reduction.

Corrosion

Field tests have continued on the application of cathodic protection to cast-iron ship-propellers in the joint programme with the British Shipbuilding Research Association. Special attention has been paid to prolonging the anode life. This has involved consideration of the contact resistance between a rotating propeller shaft and the hull. The Association's interest in the application of cathodic protection to buried cast-iron pipe lines has continued. Existing schemes have been under observation and soil surveys have been made to determine the need for cathodic protection.

Porcelain Enamelling

Work has continued on defects arising from the vitreous enamelling of iron castings. Actual temperature-cycles obtained in industrial furnaces have been determined in the laboratory. The evolution of gases during the enamelling cycle is studied by heating samples in a stream of purified argon and analysing the gases evolved by means of an infra-red gas analyser. The preliminary results indicate this technique to be a very promising method of investigation.

Cracking

An investigation has been carried out in co-operation with a member-firm on cracking in bath castings, and a correlation was obtained between the percentage of cracked castings and the amount of enamel scrap included in the cupola charges. Cracking appears to be promoted by the pick-up of antimony, boron and lead by the metal from the enamel.

Fluidity

Further work has been carried out on the fluidity of cast iron. The fluidity of hypo-eutectic cast irons increases with carbon equivalent for a fixed pouring temperature. When the normally accepted value for the eutectic composition is exceeded, fluidity continues to increase, until at some critical carbon content it is rapidly reduced.

Mechanical Properties

A preliminary programme of work has been completed on the fatigue properties of nodular cast irons of various silicon contents in the as-cast and heat-treated conditions. The importance of considerations of under-stressing and over-stressing have been dealt with and a programme of work on the effect of under-stressing on the fatigue properties of nodular cast irons has continued, using ferritic flake-graphite irons and pearlitic and ferritic nodular cast irons. A preliminary account of the effect of surface rolling on pearlitic flake-graphite irons has been issued. Fatigue tests have been carried out on hardened and tempered nodular cast irons and on nickel-free nodular cast irons. Tests are still continuing with the object of collecting comprehensive data (some of which have already been published) on the mechanical properties of the various grades of cast iron.

Galvanizing embrittlement of blackheart malleable cast iron and temper embrittlement in nodular cast irons have been the subject of an extensive investigation. Work on the mechanical properties of flake-graphite irons has been completed. The influence of sulphur and manganese content and degree of decarburization on the impact transition temperatures of whiteheart malleable have also been studied.

Soundness of Iron Castings

The influence of mould factors on the soundness of iron castings has been investigated. Measurements have been made of changes in mould cavity dimensions and casting dimensions during solidification. The effect of dry-sand moulds in producing sounder castings than green-sand moulds has been studied and reasons for the difference are now clear. Work is in progress on the effect of moulding materials and metal composition on pinholing in nodular cast irons. The influence of metal composition and section size on solidification sequences of irons of various compositions is being studied, using thermocouple and quenching techniques.

White Irons

A survey is in hand on the problem of hot-tearing of white-iron castings. A relation has been discovered between the mechanical properties and macrostructure of white cast irons. Work has been carried out on the influence of casting temperature on chill depth.

Solidification of Cast Irons

Further experiments have been carried out to elucidate the mechanism of formation of under-

British Cast Iron Research Association

cooled graphite in cast irons, on which there is still considerable disagreement. Cooling-curve and quenching experiments have been carried out in an attempt to explain the solidification of nodular cast irons and an account has been published of earlier work on the solidification of iron/phosphorus/carbon alloys.

Methods of Analysis

Much work has continued in co-operation with other laboratories on improvements in routine chemical analysis. This work has included a study of the method for phosphorus, the sampling of nodular iron for total-carbon determination, the analysis of slags, a quicker method for magnesium determination, the application of the combustion method for sulphur to coke, a rapid method for determining pitch in moulding sands, and the application of high-frequency heating for carbon determination. The spectrographic work has been concerned with the analysis of slags, the determination of small amounts of residual elements and the continued application of direct-reading methods.

Malleable Cast Iron

Work has continued on the influence of graphitization on the rate of decarburization. Manganese and sulphur play an important part, but the results appear to be influenced by any prior heat-treatment received. A co-operative study is proceeding on the production of sound test-bars in malleable cast iron.

Development Department

The Development Department of the Association has continued to give practical effect to the research work by providing the necessary liaison with the industry. The number of enquiries, both from the industry itself and from users of castings, is now higher than at any previous period in the Department's history, and the range of problems submitted is becoming wider. A particularly satisfactory feature has been the increased number of enquiries from engineering firms using, or wishing to use, cast iron and who require special information to enable them to make the most practical use of the material.

For example, information has been requested by users of castings on magnetic properties, weldability of cast iron, specification requirements for cast crankshafts, bearing surfaces, and the widespread experience available at the Association's headquarters has enabled useful advice to be given and further experience to be gained in all these problems. Some of these problems have prompted experimental work on the brazing of cast iron, the oil-firing of malleable annealing ovens, heat-resistance, etc. The Department is also responsible for work on foundry atmospheres.

Foundry Atmospheres

The section of the Department dealing with foundry atmospheres is pursuing an active programme of work on the elimination of dust from the knockout section of foundries, an extensive schedule having been laid down to determine the critical air contours required to control dust plumes under widely varying shop-conditions. Work is still going forward to control the dust produced not merely by conventional pedestal grinders, but also by portable hand grinders and swing-frame grinders. Advice is being given on working conditions in foundries, with a view ultimately to increasing the output. An investigation has also been made of factors affecting the rate of cooling of sand, and the effect of moisture on the evolution of dust from foundry sand. Preliminary work has been carried out in connection with the problem of external pollution of the atmosphere from cupola furnaces, a question of considerable importance to foundries located near to residential areas. The Association's dust-control system for pedestal grinders is now in active manufacture and supply to the industry.

Scottish Laboratory

The Department supervises the Scottish laboratories situated at Blantyre, near Glasgow, and where a staff of six is normally maintained. Here also, there has been an appreciable increase in the number of enquiries received, and the Scottish committee dealing with the laboratories has visited them during the year and has expressed itself well satisfied with the services which members have received.

Operational Research

The Operational Research Team made 125 visits to member-firms during the period under review, and the total number of visits to the end of the period (over 500 visits to over 400 foundries since June, 1950) covers foundries responsible for one-fifth of the output of the industry. The service has proved extremely popular with member-firms and many expressions of appreciation have been received.

Intelligence Department

Publications

During the year under review, 26 research reports appeared in the B.C.I.R.A. *Journal of Research and Development*. Reviews have appeared in the B.C.I.R.A. *Bulletin* on the behaviour of cast iron in seawater, the effect of aluminium on cast iron, the manufacture of abrasive shot, the sodium silicate/CO_2 process for curing moulds, and other subjects. In addition, 16 scientific contributions by the Association's staff were published by various learned societies, technical organizations and journals.

Enquiries

The Department continues to handle an increasing number of enquiries from members, users of iron castings, and students. Such enquiries are answered largely on a basis of published information and are of course additional to the routine requests to borrow literature dealt with by the library, which is housed in this Department.

Exhibition

The Association contributed an exhibit to the D.S.I.R. stand at the Engineering and Marine Ex-

hibition, at Olympia, September, 1953, including a pedestal grinder incorporating the Association's dust-control unit, a pneumatically-operated clamp for shell moulds, and sand-testing apparatus.

Conferences

A conference arranged in conjunction with the Council of Ironfoundry Associations under the title "Simplifying Foundry Operation," demonstrating the possibilities of applying work-simplification in the iron foundry, was held at Ashorne Hill in November, 1953, and its success was such that the conference was repeated in February, 1954, for the convenience of representatives of member-firms who could not be accommodated on the earlier occasion. Nearly 400 representatives attended at these conferences.

Finance and Membership

The membership of the Association continues to increase and the income and expenditure statement accompanying this report to members shows that the total income for the year was £3,368 more than the previous year. The statement includes costs incurred in connection with the "Conditional Aid" grant referred to above and re-imbursed to the Association through the D.S.I.R., and when due allowance is made for this, the excess of income over expenditure available to meet capital expenditure was £15,656, apart from depreciation, for which adequate allowance has also been made. The rise in expenditure is mainly due to increased staff salary costs consequent on increases in the Treasury scales for scientific and technical staff, which are followed by the Association. The balance sheet shows that the excess of current assets over current liabilities at June 30, 1954, was £22,920, compared with £3,440 at the end of the previous year.

The total capital expenditure for the year was £5,609, and the whole of the extensions envisaged in 1948 have been completed, including the erection and equipment of the chemical and spectrographic laboratories, the sands laboratories, provision for the Operational Research Team, Foundry Atmospheres Team and Development Department, and a block for heavy stores, in particular pig-iron and scrap. The shell of the experimental foundry has been completed; it has been recognized from the beginning that provision for equipping this building, and its operating costs, would require consideration during the quinquennial period just begun. In the meantime, this building is serving to accommodate part of the work of the Foundry Atmospheres Team, which requires space, particularly for its investigation on knock-out ventilation; this investigation will be completed before the building is required for its intended purpose.

During the year all departments have continued to work on pre-determined budgets, and the Council has kept the actual and budgeted figures of expenditure under review from month to month. As a result of the whole-hearted efforts of the staff in exercising the utmost economy in the use of materials and services, the actual total expenditure for the year was less than the budgeted figure by some £1,500.

The Report is signed by Sir Frederick Scopes, the president; Mr. J. J. Sheehan, the chairman of Council; and Dr. J. G. Pearce, O.B.E., the director.

British and World Shipbuilding

Lloyd's Return for September Quarter

Lloyd's Register of shipbuilding returns relating to merchant ships of 100 tons gross and upwards, for the quarter ended September, shows that in Great Britain and Northern Ireland at that date, steamships and motorships under construction totalled 316 ships of 2,058,457 gross tons, compared with 328 ships of 2,195,085 tons in the previous quarter. The total includes 117 steamers of 1,153,772 tons and 199 motorships of 904,685 tons. In the remainder of the Commonwealth 45 ships of 130,473 tons were under construction compared with 43 ships of 129,656 tons in the March quarter, these vessels including 20 steamers of 48,516 tons and 24 motorships of 81,747 tons. Oil tankers of 1,000 tons and upwards building in Great Britain and Northern Ireland totalled 83 ships of 1,093,530 tons compared with 89 ships of 1,135,693 tons in the June quarter, and representing 53.1 per cent. of the total tonnage under construction in this country. Ships under construction in the principal districts of Great Britain and Northern Ireland are shown in Table I.

The sizes of steamships and motorships under construction in Great Britain and Northern Ireland in the June quarter were as follow:—100 to 1,000 tons, 19 steam (74 motor); 1,000 to 2,000 tons, 5 steam (21); 2,000 to 4,000 tons, 14 steam (12); 4,000 to 6,000 tons, 4 steam (17); 6,000 to 8,000 tons, 11 steam (24); 8,000 to 10,000 tons, 11 steam (16); 10,000 to 15,000 tons, 22 steam (32); 15,000 to 20,000 tons, 11 steam (3); 20,000 to 25,000 tons, 19 steam (nil); 30,000 tons and over, 1 steam (nil).

TABLE I.—*Ships under Construction in Principal Districts of Great Britain and Northern Ireland.*

District.	September 30, 1954.		June 30, 1954.		September 30, 1953.	
	No.	Gross tonnage.	No.	Gross tonnage.	No.	Gross tonnage.
Aberdeen ..	16	21,170	20	25,652	14	26,631
Barrow ..	5	97,750	6	116,120	5	107,130
Belfast ..	17	194,350	17	222,880	16	187,310
Bristol ..	6	3,820	5	3,640	5	3,842
Clyde—						
Glasgow ..	76	475,724	84	549,571	84	562,227
Greenock ..	30	205,215	31	197,320	29	199,020
Dundee ..	6	43,800	6	37,850	7	45,510
Hartlepool ..	9	56,069	8	51,074	8	48,305
Hull	28	12,917	27	13,633	23	12,705
Leith	14	43,216	10	38,420	14	41,805
Liverpool ..	16	122,613	14	134,313	14	142,360
Middlesbrough	15	197,162	17	218,460	17	208,676
Newcastle-on-Tyne ..	34	364,585	40	382,809	42	393,130
Southampton	3	5,434	4	6,154	6	6,824
Sunderland ..	27	206,927	26	191,095	29	203,255

Steamships and motorships under construction abroad, excluding China, Poland, and Russia, at the end of September totalled 749 ships of 3,440,621 tons gross; a decrease of 213,185 tons as compared with the figures published for June last. Oil tankers under construction total 175 ships of 2,125,230 tons, which is 92,599 tons less than in June last, and represents 61.8 per cent. of the total tonnage being built abroad.

H

Damages Payment Over 323 Years*

If a trade union finances litigation on behalf of a member and loses the case, the member, not the union, is responsible for the payment of any costs awarded the other party. This important aspect of workmen's-compensation cases was emphasized in a case at Hitchin County Court recently. A judgment summons had been brought against Mr. Herbert Sidney Adsett, of Hitchin, formerly an employee of K. & L. Steelfounders and Engineers, Limited, Letchworth. The sum involved was £970 1s. 11d. Those were the costs he had been ordered to pay after he had, with the aid of the Amalgamated Union of Foundry Workers, fought a claim through the High Court and Appeal Court for compensation on the grounds that he had contracted pneumoconiosis at work.

At Hitchin County Court on August 13, Adsett had stated that he was now employed by Letchworth U.D.C. as a road sweeper. He said he did not know that, if he lost the case, he might have to pay a considerable sum in costs to the other side. Commenting then that this case was very illustrative of a defect in our laws—a defect apt to cause very grave injustice, the Judge had adjourned the case to give the Union an opportunity of considering whether they would make some contribution towards the costs.

At the adjourned hearing, Mr. P. H. Ripman (for K. and L.) stated that the Union's solicitors had been consulted and had stated that the Union was not prepared to pay. In order that the matter of Mr. Adsett's rights under Union rules might be known to the Court attempts had been made to serve a subpœna on the general secretary of the Union in Manchester, but he could not be found. He therefore asked that the case be further adjourned in order to get the secretary or some other responsible official of the Union before the Court. Mr. Ripman added that Mr. Colin Fawcett, who had represented Adsett at the previous Court, had stated that the Foundry Workers' Union was a poor Union. He (Mr. Ripman) had since seen the Union's balance sheet for 1953, and it showed assets just short of £1 million.

Opposing the application for an adjournment, Mr. Platts Mills said that his instructing solicitors had offered to accept service of the subpœna on the secretary, but this was not done. In any case, to start exploring the means of the Union was quite irrelevant; the law specifically stated that this inquiry should be limited to the debtor's means. As for the Union rules, which could have been obtained by Mr. Ripman for a shilling, they expressly excluded any liability in the event of the failure of a claim by a member, backed by the Union.

Judge Lawson Campbell said he previously adjourned the case in order that the Union might consider making a voluntary contribution to the successful defendant's costs. It was never suggested that they were under any legal compulsion to do so. "I am told that they have considered it and that they don't desire to make any contribution. It is entirely a matter for them," he said. "All I have to do now is to consider Mr. Adsett's means, which are quite minute, and I am going to make an order that he pays 5s. a month."

* See also p. 254 September 2, 1954, FOUNDRY TRADE JOURNAL.

Notes from the Branches

Lancashire

The Lancashire branch of the Institute of British Foundrymen recently visited the works of Newton Chambers & Company, Limited, Thorncliffe, near Sheffield. Some 50 members made the trip, and saw the light mechanized foundry, the heavy jobbing foundry, the machine-shops, the training centre, and finally a film show depicting the company's work. Warm thanks were expressed by the Lancashire branch representatives for the hospitality extended by the firm, and the illustration below shows some of the party at luncheon, together with representatives of Newton Chambers.

Lancashire branch visit to Newton Chambers & Company, Limited (from left to right): J. Baxendale (R. Baxendale, Limited, Chorley); Mr. L. Godber (Newton Chambers); Mr. F. W. Nield (branch secretary); Mr. K. E. Walker (Newton Chambers); Mr. E. Jackson (branch president); Sir Harold West (managing director, Newton Chambers); Mr. E. Beech (Metropolitan-Vickers Electrical Company, Limited, Manchester); and Mr. F. H. Hoult (Newton Chambers).

New Equipment

Filler for Light-alloy Castings

A new universal filler composed of metallic powders in resins has been recently developed by Birmetals, Limited. Primarily designed for motor-body repairs, *i.e.*, filling in dents, holes, etc., it can also be used to fill superficial defects on aluminium-alloy castings as well as for surface filling other castings before painting, so long as the filled portion does not undergo undue stresses in service. The material, which is known as "Filzall," is applied at a low temperature, as this avoids the disadvantages of soldering and welding, etc. The filler can be applied with a hot spatula, a blow-lamp or welding torch and worked with wooden paddles. It should not be used where the temperature is likely to exceed 175 deg. C. The filler is very light, that is, about a quarter the weight of metallic solders, and two sticks (about 4 oz.) will fill as much space as 1 lb. of metallic solder. It is claimed that it needs no special skill to apply, and that the repaired part can withstand paint stoving temperatures of 130 deg. C.

Shell-moulding Machine

A new shell-moulding machine (Fig. 1) has been developed by Fairbairn Lawson Combe Barbour, Limited, of Leeds, and put into operation at the works of Victor Products (Wallsend), Limited, Wallsend-on-Tyne. This machine, which has been named Shelmolda "Altus," has two moulding units, each utilizing a gas-heated oven for preheating and curing the moulds. The moulding units take patternplates 16 by 16 in. and 16 by 12 in. and are so arranged as to permit the use of a pattern up to 13 in. in height or depth and to give ample final ejector clearance of the mould from the patternplate. The curing ovens are fitted with doors divided horizontally into two sections and pneumatically operated, limiting the size of opening to that required to admit the mould, in order to conserve heat. The ovens are also fitted with temperature indicators and thermostatically-controlled regulators. Between the moulding units, is the central dump box, capacity 220 lb., carrying the sand mixture, and operated pneumatically and controlled electronically. The machine, which occupies floor space 12 ft. 2 in. by 3 ft., is complete with spray guns, blowing nozzles, air reducing valves and regulators, speed valves and piping suitable for connection to compressed-air supply mains.

The machine is designed for operating the now well understood moulding cycle, involving the use of preheated patternplates. The mixture of sand in use at the Victor Products works is composed of fine silica sand with a 5 per cent. content of phenolic resin and is used perfectly dry. Mould making with this machine is neither involved nor difficult as it functions semi-automatically and all necessary equipment is conveniently placed to simplify and ease the work of the operator; it is noteworthy that all components in the cycle—investing, curing and ejection—are always within the operator's control. Although a moulder operates the machine at Victor's works, an unskilled worker would probably fulfil all requirements adequately.

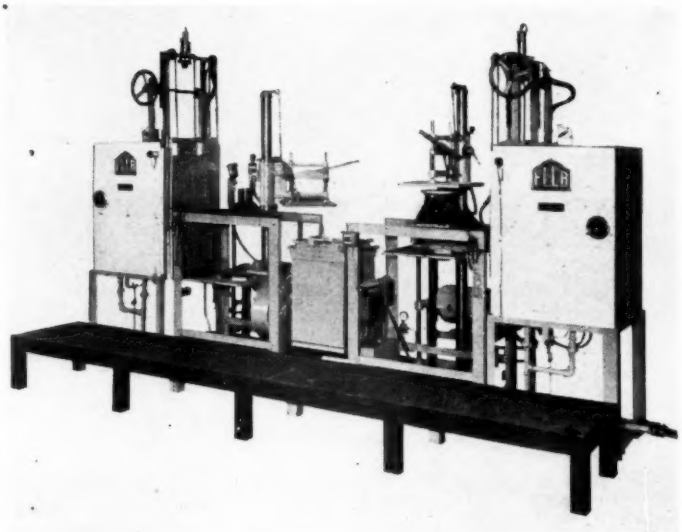


FIG. 1.—*Shelmolda "Altus" model made by Fairbairn Lawson Combe Barbour, Limited.*

Operating the Machine

Stages in the operating cycle of the machine, working on reflector castings at Victor Products, are shown in Fig. 2. The ovens are maintained at a temperature of 370 to 430 deg. C. and iron patternplates are in use of fairly heavy design, so that they retain their heat satisfactorily. A frame, located on runners on the moulding unit, carries fitments to connect with the dump box as a locking hinge. Initially, the temperature of the pattern is tested with a contact pyrometer. When the patternplate is engaged and turned face downwards over the dump box, a push-button is pressed to automatically reverse the dump box and patternplate. For the example illustrated, the duration of investment is 10 sec.—a time predetermined and controlled by an electronic mechanism—then the dump box rights itself automatically. While the first shell is being cured a further "green" shell can be prepared on the second half pattern and this in turn cured in the second oven.

Ejection of shells from the patterns is effected by reversing the patternplates (Fig. 2 (*e*) and (*f*) in specially constructed holders and applying pressure downwards to ejector pins located in the plate. It is thought this is the first machine to employ downwards ejection to strip the shell half-mould. The ejected shell is caught on a receptor motion and automatically lowered clear of the patternplate. The whole operation of preparing two half-moulds ready for assembly occupies about one minute.

Mould Assembly

At Victor Products mould assembly is effected by

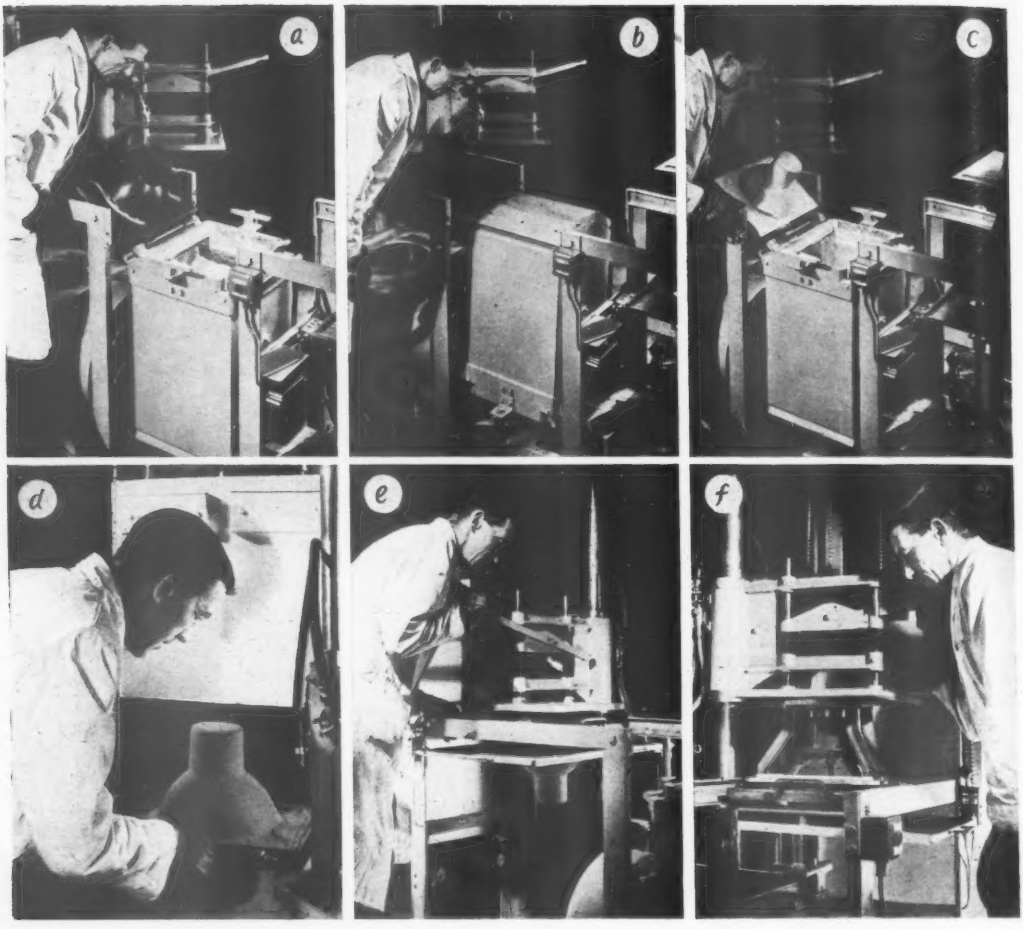


FIG. 2.—*Stages in shell-moulding a reflector casting 13-in. deep: (a) The pattern after spraying is swung over the dump box; (b) the dump box is inverted mechanically; (c) patternplate, complete with "green" shell is removed and (d) pushed into the oven. After curing it is taken out and reversed ready for ejection, effected by swinging over the ejection mechanism and depressing the hand lever (e). A second half-shell is prepared in a similar manner on the other side of machine and the ejection mechanism for this shell is shown at (f).*

applying a resin paste to both parts, bringing the halves together (locating by pre-arranged male and female dowels) and, after pressing together, placing an oven under the pressure of a rubber pad. Metal is cast into the moulds without backing. Fig. 3 shows two half-moulds for the reflector casting as well as the casting produced.

FIG. 3.—*Shell halves and a finished reflector casting made at Victor Products, Limited.*

Metallic-arc Welding of Spheroidal-graphite Cast Iron*

By F. A. Ball, B.Sc., A.C.T. (B'ham) and D. R. Thorneycroft, B.Sc., A.C.T. (B'ham), A.I.M.

(*Continued from page* 507)

Machinability

One aspect of the welding of cast iron which is sometimes of interest to the user of welded castings is that of machinability. It was evident from the examination of the joints in the s.-g. iron plates that at the weld junction a narrow zone of high hardness was created by the formation of cementite and martensite during welding. The hardness of this zone was a maximum of about 600 D.P.N. near the surface of the weld.

The opportunity was taken during the preparation of test-pieces to obtain an idea of the effect of this hard zone on the relative machining characteristics of the various joints and the effect of heat-treatment. The tensile test-pieces were turned from 1-in. square bars: the appearance of four of the bars when they had been machined to a little under 1-in. diameter is shown in Figs. 17 and 18. It was observed during the turning operation that the hard heat-affected zone in the as-welded bars seriously impaired machinability (Fig. 17) and the cutting edge of the high-speed tool was rapidly dulled. Furthermore, it was necessary to reduce the cutting speed to 26 ft. per min. over the weld zone. The machinability of the bars heat-treated at 550 to 600 deg. C. was noticeably better (Fig. 18*a*) and in the fully-ferritized bars the influence of the heat-affected zone on machinability was found to be completely removed (Fig. 18*b*).

In addition, one of the as-welded pearlitic plates was machined on the surface by shaping, using a tipped tool and a cutting speed of 46 ft. per min. The depth of the cut was 0.030 in. and the feed 0.010 in. The appearance of the machined surface was as in Fig. 19. The shaping operation was not markedly affected by the presence of the hard heat-affected zone.

Consideration of Results Obtained with Nickel/Iron Electrodes

From an examination of the tensile and bend properties of the welded joints made with the nickel/iron electrode it was concluded that the strength and ductility of butt-welds in s.-g. iron would probably

* Paper presented at the fifty-first annual meeting of the Institute of British Foundrymen, held in Glasgow.

FIG. 17.—*Machined surfaces of* (*left*) *pearlitic and* (*right*) *ferritic iron bars turned from welded plates of s.-g. iron* 1-*in. thick.* (*Actual size.*)

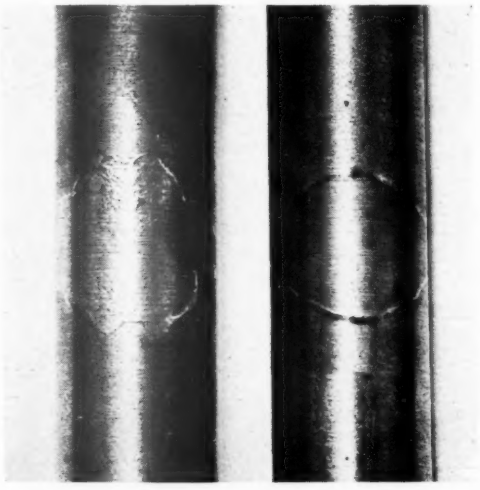
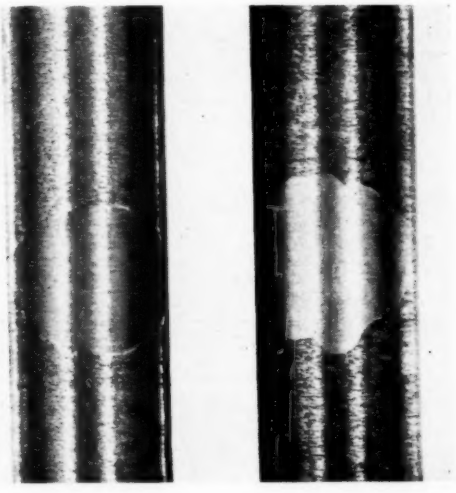


FIG. 18.—*Machined surfaces of bars turned from welded plates* 1-*in. thick of pearlitic s.-g. iron after heat-treatment* (*left*) *for* 2 *hr. at* 550 *deg. C. and* (*right*) *fully ferritized.* (*Actual size.*)



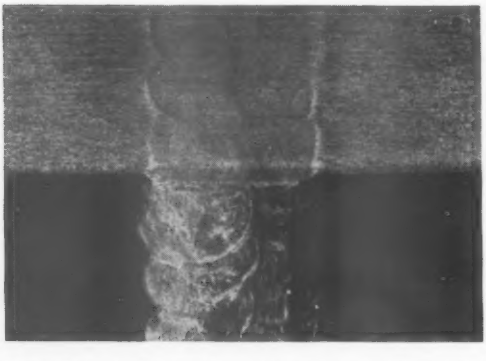


FIG. 19.—*Surface of weld after shaping of a pearlitic iron plate 1-in. thick as welded. (Approx. full size.)*

be adequate for many applications of this type of material. In the as-welded condition the ductility of the joint was improved by heat-treatment, but in the case of pearlitic iron this involved some sacrifice in tensile strength. The formation, during welding, of the narrow zone of eutectiferous cementite and hard transformation products introduced machining difficulties which were partially removed by treatments at relatively low temperatures. Good machinability was achieved when the joints had been given a ferritizing treatment. There was some evidence to indicate that the presence of the zone of cementite weakened the joint under certain conditions of impact testing.

These findings indicated the need to study the possibility of restricting the formation of the cementite zone by reducing the intensity of the thermal disturbance in the cast iron at the weld junction through the use of an electrode requiring a lower electrical energy for its deposition than was involved in using the nickel/iron electrode. For this reason it was decided to test the welding response of s.-g. iron using an aluminium-bronze electrode. The electrode used was reported to give weld metal deposits containing approximately 82 per cent. copper, 10 per cent. aluminium, 4 per cent. iron and 4 per cent. nickel having a tensile strength of 37 to 41 tons per sq. in.

Preparation and Examination of Aluminium-bronze Welded Joints

The preparation of welded joints was carried out initially in the same manner as when using the nickel/iron electrode, but, for reasons described below, some modifications in welding procedure were used at a later stage. The electrode was available in 10- and 8-gauge: the smaller size was used in the deposition of root runs. The usual drying conditions were employed, and deposition was made using a direct current (electrode positive) of 75 amp. with the 10-gauge and 95 amp. with the 8-gauge electrode.

In the ½-in. plates of ferritic and pearlitic iron longitudinal cracks and occasional transverse cracks developed in the root of the weld when deposition of the third weld layer in the single-vee joint was in progress. This cracking occurred at a relatively low temperature and was apparently connected with the deflection of the plates during welding, which imposed tensile stresses on the weld metal in the root run. To minimize this effect a pair of ferritic plates was clamped to the welding bench, with a root gap of 0.005 in. These were welded in the usual manner. The joints appeared to be free from cracks at all stages of preparation.

When welding the 1-in. thick plates longitudinal cracks developed in the first root run soon after completion of the root run on the opposite side of the double-vee butt-joint. The aluminium-bronze weld metal was quite fluid and it was possible to weld-up the major cracks as they occured, because the molten metal penetrated the crevices readily. The joint was completely without further cracking. When the 1-in. plates were clamped to the welding bench to prevent their deflection, transverse, instead of longitudinal cracking occurred in the aluminium-bronze weld metal. This procedure was abandoned.

Tensile test-pieces 0.505-in. diameter were machined from the welded joints of the 1-in. thick plates of both grades of iron, in the manner described previously, and a few bend-test and Charpy-impact test-pieces were machined from the ½-in. plates.

TABLE VII.—*Tensile Properties of Joints in Plates of S.-g. Cast Iron 1-in. thick (Aluminium-bronze Electrode).*

Initial plate structure.	Condition of plate.	Yield point, t.s.i.	U.T.S., t.s.i.	Elongation on 2 in., per cent.	Reduction of area, per cent.	Position of fracture.
Pearlitic	Unwelded	30.2	46.8	5	5	—
	As-welded	n.d.	17.8	1½	n.d.	Weld metal/weld junction
		n.d.	14.7	½	n.d.	Weld metal/weld junction
		n.d.	14.5	n.d.	n.d.	Weld metal/weld junction
	Welded + 8 hr./900 deg. C. + 16 hr./700 deg. C.	n.d.	13.0	n.d.	n.d.	Weld metal*
		n.d.	11.0	½	n.d.	Weld metal*
		n.d.	11.2	n.d.	n.d.	Weld metal/weld junction
Ferritic	Unwelded	24.6	31.3	16½	13	—
	Welded + 2 hr./850 deg. C. + 8 hr./700 deg. C.	n.d.	11.5	n.d.	n.d.	Weld metal/weld junction
		n.d.	21.4	n.d.	n.d.	Weld metal/weld junction
		n.d.	22.4	n.d.	n.d.	Weld metal/weld junction

n.d. = Not determined. * Failure occurred at Al-bronze/Fe-rich phase interface.

Some of the plates were heat-treated as indicated in the table of mechanical properties (Table VII). A microscopical examination was made of cross-sections from selected welds.

Microscopical Examination

The structure at the root of the weld in a pair of ½-in. pearlitic plates welded without restraint is reproduced in Fig. 20, which demonstrates the cracking which occurred. Three principal zones of structure are featured in this photomicrograph: (1) the s.-g. iron occupies the lower third of the picture, in a vee-shape, and fine plates of eutectiferous cementite are just discernible in the plate structure; (2) also in vee formation, and lying next to the s.-g. iron, is a substantial layer of iron-rich phase, which was formed by marked interfusion between the aluminium-bronze weld metal and the cast-iron plate; (3) above this layer occurs the aluminium-bronze weld metal which contains also large globules of an iron-rich constituent. Coarse particles of graphite derived from the spheroids in the plate material occur in the aluminium-bronze weld metal and fine irregularly-shaped graphite particles are present in the globules and massive aggregates of the iron-rich phase. The amount of graphite occurring in this phase in the upper regions of the weld was much less.

It is supposed that the tensile forces acting on the centre line of the weld reached a critical value and that cracking then occurred suddenly, and, as shown in Fig. 20, progressed directly into the weld metal through the iron-rich phase. On encountering the aluminium-bronze weld metal the crack branched, and followed what seemd to be a discontinuity in the aluminium-bronze bordering the iron-rich constituent. This discontinuity was observed in the aluminium-bronze weld metal in the root zone of the joints: a typical example is shown in Fig. 21. Occasionally a similar defect was observed, in an intergranular distribution, in the root weld metal: both types were considered to be a manifestation of hot-shortness. The defect was not observed at positions higher in the weld metal than the root zone and it was always in the vicinity of the massive iron-rich phase. The quantity of iron-rich phase formed in the root zone varied from joint to joint, and sometimes the aluminium-bronze weld metal was co-present in the actual root, lying between two formations of the iron-rich constituent. In this case the cracking, for example in the ½-in. plates welded without restraint, occurred in the aluminium-bronze weld metal, again at a position close to the iron-rich phase. Occasionally the extreme root of the weld was composed almost entirely of aluminium-bronze weld metal, as illustrated in Fig. 22. The plates in this instance had been welded under restraint and the joint appeared to be sound. However, in the upper regions of the weld short cracks had occurred in the iron-rich phase. The appearance of one of these is illustrated in Fig. 23, and it is evident that the phase is quite brittle.

A more detailed examination of the weld junction, depicted in Fig. 22, indicated the thermal disturbance in the cast iron to be relatively small, as illustrated in Fig. 24. The cast iron had not melted to form pools of eutectic, but had transformed only to martensite at the weld junction. This condition resembled that present in oxy-acetylene bronze-welded joints. Further examination revealed the presence of a shallow iron-rich layer between the aluminium-bronze weld metal and the cast iron, as shown in Fig. 25. The more usual structure at the weld junction consisted of hard transformation products and pools of eutectiferous cementite in the cast iron, extending into a deep layer of iron-rich constituent lying next to the aluminium-bronze weld metal: see Fig. 26.

Mechanical Properties

The tensile properties of the joints welded with the aluminium-bronze electrode are summarized in Table VII. None of the joints showed tensile strengths above 22.4 tons per sq. in. and the majority of the values were in the range of 11 to 15 tons per sq. in. All the joints had low ductility as measured by the values for percentage elongation and reduction of area. Failure occurred primarily in the zone of weld metal close to the

TABLE VIII.—*Unnotched Charpy-impact Properties of Welded Joints in Plates of S.-g. Cast Iron ½-in. Thick (Aluminium-bronze Electrode.)*

Line of impact.	Condition of plate.	Initial plate structure.	Impact strength at 25 deg. C., ft.-lb.	Position of fracture.
Centre line of weld ...	As-welded	Pearlitic	18 14½	Started in Al-bronze weld metal but propagated along Fe-rich interface.
		Ferritic	14½ 14½	Centre line of weld.
		Ferritic	14½	Followed interface between bronze and Fe-rich phase.
1 mm. from weld junction at weld surface	Fully-ferritised... ...	Pearlitic	7 7	Started in Al-bronze weld metal but propagated along bronze/Fe-rich interface.
		Ferritic	7 7	
Centre of test-piece ...	Unwelded	Pearlitic	7 11	
		Ferritic	95 86	

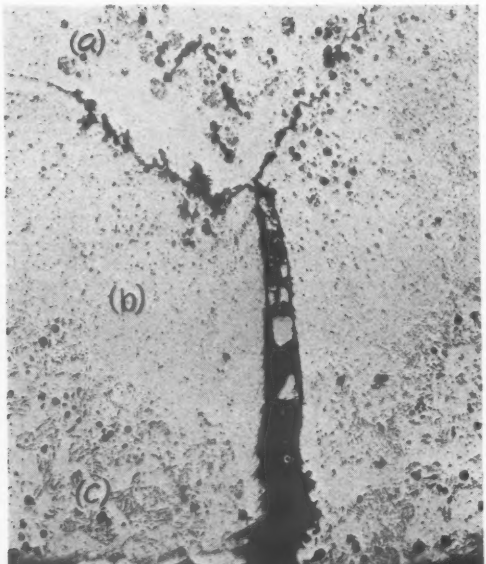


FIG. 20.—*Structure at the root of the joint in welded pearlitic iron plate: (a) Al-bronze weld metal, (b) Fe-rich phase, and (c) s.-g. iron.* (× 40.)

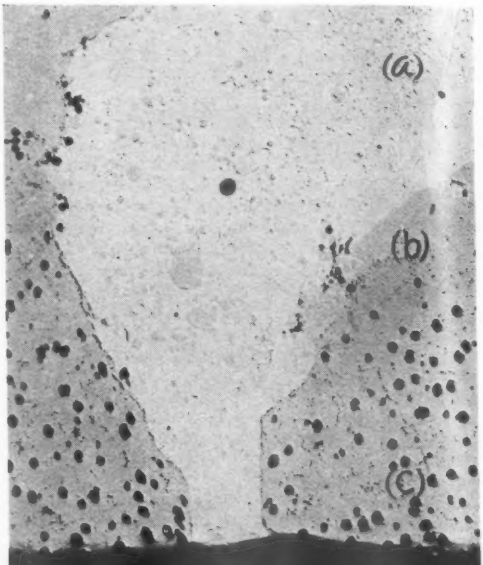


FIG. 22.—*Structure at the root of the joint in welded ferritic iron plate: (a) Al-bronze weld metal, (b) Fe-rich phase, and (c) s.-g. iron.* (× 40.)

FIG. 21.—*Discontinuity in Al-bronze weld metal near the iron-rich phase.* (× 100.)

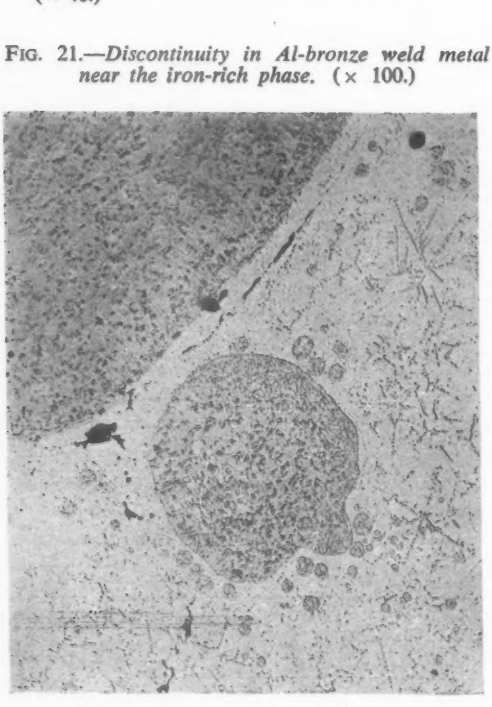


FIG. 23.—*Brittle failure in the iron-rich phase.* (× 300.)

weld junction. In view of the evidence obtained from the microscopical examination of the joints, the poor tensile properties of the welded joints are attributed to the presence of fine discontinuities in the aluminium-bronze weld metal at the root of the joint and to fine cracks in the iron-rich phase.

The bend properties of joints in ½-in. ferritic plate welded under restraint were determined on 6-in. long by 1-in. wide test-pieces, in the manner described previously, with the load applied to the root of the weld. In the as-welded condition angles of bend of 2 to 3 deg. were obtained with a load-to-failure of 1 to 1½ tons. The fully-ferritized joints gave bend angles of 7 to 8 deg. with failing loads of 1.6 to 1.9 tons. All the welds started to fail in the aluminium-bronze weld metal at the weld surface, but the path of fracture was mainly in the zone of iron-rich phase present at the weld junction.

The unnotched Charpy impact properties of the joints were determined, using the test-pieces described in Fig. 5 (*a*). The line of impact was selected to pass through either the centre line of the weld, or through the position in the weld metal 1 mm. from the weld junction. Only a few values were obtained: these are presented in Table VIII. The value of impact strength depended on the position of striking: it was about 14½ ft.-lb. for the centre-line position and 7 ft.-lb. for the position near the weld junction. Failure occurred mainly at the junction of the aluminium-bronze and the iron-rich phases. The impact values obtained for the fully-ferritized joints were appreciably lower than those obtained with the nickel/iron electrodes under the same conditions of testing.

Hardness determinations were made in the heat-affected zone and in the weld metal of the joints in the ½-in. thick pearlitic plates, the result of a hardness survey across the joint in an as-welded plate being presented in Fig. 7*b*. This shows that the highest hardness occurred at the weld junction and in the adjacent weld metal. The plateau of high hardness (about 650 D.P.N.) in Fig. 7*b* was obtained on the layer of massive iron-rich phase next to the cast iron.

Measurements at selected positions in the weld metal showed the iron-rich phase to reach a hardness of 700 D.P.N. This high hardness was not affected by treatment at 550 deg. C. for 2 hrs., but the full-ferritizing treatment reduced it to 310 D.P.N. and caused fine, irregularly-shaped particles to precipitate in the larger aggregates of the constituent. The average hardness in the aluminium-bronze weld metal was 190 D.P.N. near the weld surface and 210 D.P.N. in the root of the weld.

Certain features of the cracking in the aluminium-bronze welds suggested that the higher thermal contraction which a high-copper alloy would be expected to have, relative to a nickel/iron alloy, was a contributing factor in the cracking. Excessive contraction was thought also to have been the cause of the lifting of the edges of the weld beads of aluminium-bronze from the surface of cast iron, as shown in Fig. 27. This line of thought could not be followed with the data available, so dilatation tests were made on all-weld-metal deposits from the aluminium-bronze and nickel/iron electrodes, and on a sample of the ferritic s.-g. cast iron.

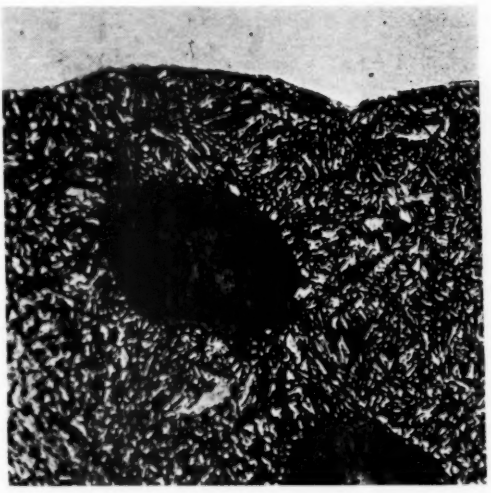
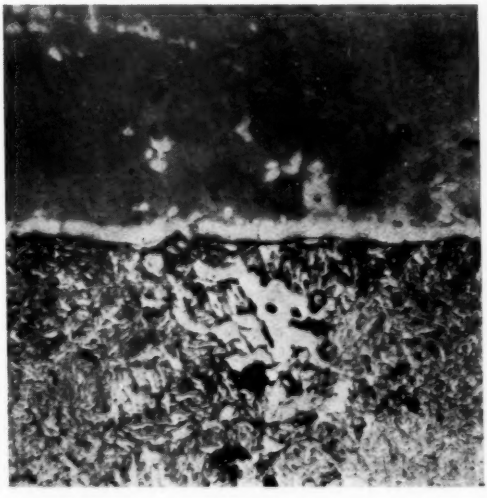


FIG. 24.—*Absence of eutectiferous cementite at the weld junction in a ferritic iron plate.* (× 750.)

Test-pieces, 1-in. long and 0.110-in. dia. were heated rapidly in a dial-gauge dilatometer to about 950 deg. C. and then cooled in air to 25 deg. C. The dilatation curves obtained on cooling are presented in Fig. 28. It is seen that the total contraction of the aluminium-bronze weld metal when cooled from the peak temperature to 25 deg. C.

FIG. 25.—*Shallow layer of Fe-rich phase at the weld junction in a ferritic iron plate.* (× 750.)



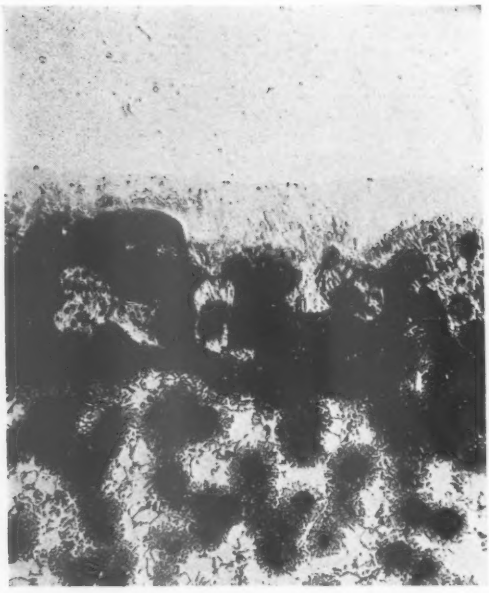
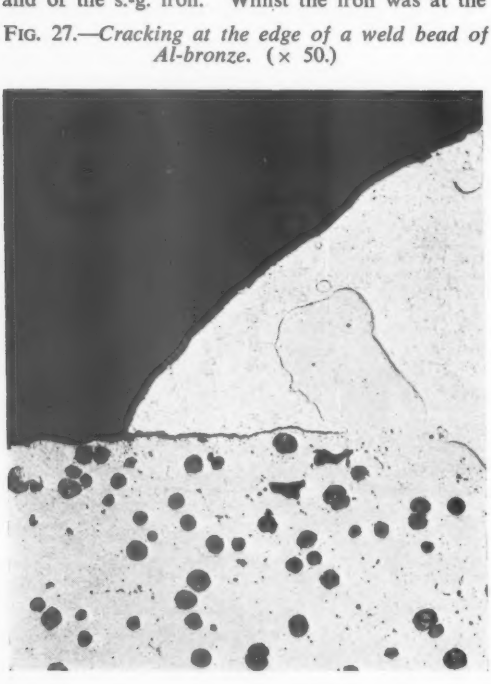


FIG. 26.—*Normal structure at the weld junction in a ferritic iron plate as welded.* (× 100.)

was greater than that of the nickel/iron weld metal and of the s.-g. iron. Whilst the iron was at the higher temperatures, carbon diffused from the graphite spheroids into the matrix of the iron; during the subsequent rapid cooling the resulting carbon-containing austenite transformed mainly to martensite. The start of this martensitic transformation is indicated by a sharp inflection, A, on the curve, at about 200 deg. C. Below this temperature the iron expanded, with the result that at 25 deg. C. the overall contractions of the cast iron and the nickel/iron weld metal were similar.

FIG. 27.—*Cracking at the edge of a weld bead of Al-bronze.* (× 50.)



Comments

The investigation described here of the metallic-arc welding of s.-g. cast iron using the nickel/iron and aluminium-bronze electrodes indicates that crack-free joints can be obtained with the former electrode in both pearlitic and ferrite iron.

Restrained joints can be arc welded with the aluminium-bronze electrodes free from visible cracking, but the joints so prepared have poor mechanical properties which are not improved by heat-treatment. The poor properties are attributed to the presence of hard brittle zones in the weld metal which are only partly softened by heat-treatment, and to internal "discontinuities."

The mechanical properties of joints welded with the nickel/iron electrodes do not reach those of the plate material, those in pearlitic iron being somewhat lower in strength and those in ferritic iron lacking some ductility. This latter deficiency can be partly rectified by heat-treatment. The thermal disturbance due to welding results in the formation of a narrow hard zone in the cast iron adjacent to the weld metal which causes difficulty in machining. Heat-treatment after welding gives a fully machinable joint.

An examination of these results from the point of view of the reclamation of defective castings points to the need to carry out repair welding prior to any heat-treatment, as the heat-treatment used to modify the properties of the casting will remove most of the deleterious effect of welding. A pearlitic casting pre-heated to 200 deg. C. prior to welding and subsequently given the full ferritizing heat-treatment will be fully machinable, and will have similar mechanical properties over the whole casting except that the welded areas will be slightly deficient in ductility.

When castings are welded to form part of a fabricated structure it will not usually be possible to heat-treat the casting fully after welding. Many of the castings used in this way will be in the ferritic condition and will therefore be weldable without pre-heating, even under conditions of restraint. Unless the structure, including the casting, can be heat-treated, machining of the welded joints may be difficult and the joints will lack some ductility. The remainder of the casting will in no way be affected by the welding. To what extent this lack of uniformity of mechanical properties in the welded structure is deleterious will depend on the service conditions which the structure has to meet.

A considerable part of this investigation has been devoted to a detailed study of the changes which

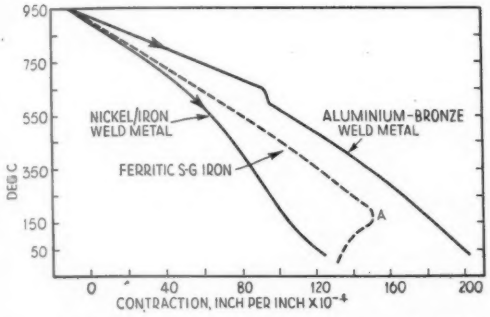


FIG. 28.—*Dilatation curves of s.-g. iron and weld-metal samples, cooled in air.*

occur in the microstructure of the cast iron due to welding. This study has supplied the explanation to the hardening which occurs in the heat-affected zone adjacent to the weld and has enabled the effects of the various heat-treatments on this zone to be understood. It has shown that this hardening will occur in any arc welding operation in which fusion of the cast iron takes place. It was hoped that the formation of this hard zone would be restricted by using the aluminium-bronze electrode, but conditions at the weld junction were worsened by the formation of a layer of a hard brittle iron-rich constituent in addition to an underlying hard zone in the cast iron. Isolated examples were recorded, however, where the aluminium-bronze had been deposited without fusion of the cast iron, and these conditions eliminated almost entirely the formation of this hard constituent in the weld metal, whilst the adjacent cast iron was free from cementite. The structure of such joints resembled that of an oxy-acetylene bronze-welded cast iron. It seems unlikely that the metallic-arc deposition of the aluminium-bronze weld metal could be controlled in practice to give, consistently, this type of structure at the weld junction. The Authors made some experiments with a method of welding which had been suggested in the Russian literature,[7] using a carbon-arc welding technique and an aluminium-bronze filler wire. The idea was to strike an arc between the carbon electrode and the filler wire and so melt and flow the bronze alloy into the vee of a butt-joint. The preliminary tests showed the method to be difficult to apply, but the occasional success achieved led the Authors to feel that the technique warrants further attention.

The Authors acknowledge their indebtedness to the Mond Nickel Company, Limited, for permission to publish this Paper, and wish to express their thanks to Mr. G. V. Walton, who assisted so materially in the production of the welded test-pieces.

REFERENCE

[7] Khrenov, K. K., and another, "New Arc-welding Processes for Cast Iron," *Autogennoe Delo*, 1952, **23**, 3-6.

Company News

OXLEY ENGINEERING COMPANY, LIMITED—A dividend of 17½ per cent. is announced for the year to June 30, which compares with 15 per cent. and a bonus of 2½ per cent. for the previous year.

WOMBWELL FOUNDRY & ENGINEERING COMPANY, LIMITED—Output for the year to July 31 was a record. The first schedule extension to the moulding shop has been completed, and further development and repair work is in hand.

PROJECTILE & ENGINEERING COMPANY, LIMITED—With the resumption of interim dividends the company is paying 5 per cent., less tax, for the year to December 31. Single payments of 20 per cent. each were made for the past two years.

LAPORTE INDUSTRIES, LIMITED—The directors announce that they have received from members of Fullers' Earth Union, Limited, acceptances totalling over 90 per cent. of each class of capital of that company and that the offer is now unconditional.

HOPKINSONS, LIMITED, engineers, founders, makers of boiler mountings, etc., of Huddersfield—The interim dividend is being raised from 7½ per cent. in the previous year, to 10 per cent. in respect of the year to January 31, 1955. A final dividend of 12½ per cent. made 20 per cent., less tax, on the £700,000 ordinary capital for 1953-54.

PICKFORD, HOLLAND & COMPANY, LIMITED, manufacturers of basic bricks and fire-resisting products, of Sheffield—A final dividend of 6½ per cent. and a bonus of 2 per cent. are recommended on increased capital of £342,000. Last year 12½ per cent. and a bonus of 2½ per cent. were paid. The total net distribution of £22,572 goes against £17,634.

B. O. MORRIS, LIMITED, manufacturers of flexible shafting and shaft machines, of Coventry—The company announces a dividend of 2 per cent., tax free, out of realized capital profits. An interim dividend of 5 per cent., less tax, has already been paid for the current year ending January 31, 1955. For the previous year a total dividend of 15 per cent., less tax, was paid.

LEEDS FIRECLAY COMPANY, LIMITED—For the year to June 30, the company is paying a dividend of 6 per cent. on ordinary stock, against 5 per cent. in 1952-53, and 8 per cent. on preferred ordinary stock, compared with 7 per cent. previously. After tax of £45,582, against £7,287, and increased charges for depreciation and kiln repairs, the net profit is little changed at £54,788 (£54,178). Trading profit advanced from £117,651 to £169,733.

HOWARD & BULLOUGH (SECURITIES), LIMITED—Negotiations are well advanced concerning an offer to be made by Singer & Friedlander, Limited, the London merchant bankers, for the £1 ordinary units, of 25s. 9d. in cash and one 4s. share in a new company to be formed to acquire the company's unquoted investments. Stockholders who accept the offer will be given an opportunity of purchasing Howard & Bullough's holding of the shares of Textile Machinery Makers, Limited.

R. & W. HAWTHORN, LESLIE & COMPANY, LIMITED, marine engineers and shipbuilders, of Newcastle-upon-Tyne—A final dividend of 11 per cent. is recommended by the company on the ordinary capital increased by a 50 per cent. scrip issue to £1,343,531 in respect of the year ended June 30 last. This distribution requires £81,283, against £64,042, required to pay a 13 per cent. final on £895,687 a year ago. The 6 per cent. interim for 1953-54 on the smaller capital compared with 5 per cent. previously.

British Blast Furnaces in the September Quarter, 1954

(These tables are published through the courtesy of the British Iron and Steel Federation.)

Derbyshire, Leicestershire, Notts, Northants, and Essex.

Name of firm.	In blast at end of the third quarter, 1954.					Weekly average in blast.	Total existing at end of quarter.
	Hematite.	Basic.	Foundry and forge.	Ferro-alloys.	Total.		
Clay Cross	—	—	1	—	1	1	2
Ford Motor	—	—	1	—	1	1	1
Holwell Iron	—	—	3	—	3	3	4
Kettering Iron & Coal	—	1	1	—	2	2	2
New Cransley Iron & Steel	—	—	1	—	1	1	2
Renishaw Iron	—	—	1	—	1	1	2
Sheepbridge	—	1	1	—	2	2	2
Stanton Ironworks: Stanton-by-Dale	—	—	4	—	4	4	5
Staveley Iron & Chemical	—	—	3	—	3	3.6	4
Stewarts and Lloyds: Corby	—	4	—	—	4	3.6	4
Wellingboro' Iron	—	2	—	—	2	2	3
TOTAL	—	8	16	—	24	24.2	31

Lancashire (excl. N.-W. Coast), Denbighshire, Flintshire, and Cheshire.

Brymbo Steel	—	—	—	—	—	0.2	1
Darwen & Mostyn	—	—	—	1	1	1	1
Lancashire Steel Corp'n.	—	2	—	—	2	2.1	3
Summers, J.	—	1	—	—	1	0.9	1
TOTAL	—	3	—	1	4	4.2	6

North-West Coast.

Barrow Ironworks	2	—	—	—	2	2	4
Charcoal Iron	—	—	—	—	—	—	1
Millom & Askam	2	—	—	—	2	2	3
United Steel: Workington	2	—	—	1	3	3	3
TOTAL	6	—	—	1	7	7	11

Lincolnshire.

Appleby-Frodingham	—	3	—	—	3	4.3	6
Lysaght's Scunthorpe Works	—	3	—	—	3	3	4
Thomas, R., & Baldwins: Redbourn	—	2	—	—	2	2	3
TOTAL	—	8	—	—	8	9.3	13

North-East Coast.

Consett Iron	—	3	—	—	3	2.8	3
Dorman, Long: Acklam	—	2	—	—	2	2.4	4
Redcar	—	2	—	—	2	2	2
Cleveland	—	2	—	—	2	2	4
Bessemer	—	2	—	—	2	2.4	3
South Bank	—	—	—	2	2	2	3
Gjers, Mills & Co.	2	—	—	—	2	2	5
Normanby Ironworks	2	—	—	—	2	2	3
Skinningrove Iron	—	1	—	—	1	1.3	3
South Durham Steel & Iron:							
West Hartlepool	—	2	—	—	2	2	2
Cargo Fleet	—	2	—	—	2	2	2
TOTAL	4	16	—	2	22	22.9	34

Scotland.

Bairds & Scottish Steel: Gartsherrie	1	1	1	—	3	3	5
Carron	—	—	1	—	1	1	4
Colvilles: Clyde Works	—	3	—	—	3	3	3
Dixon's	—	2	—	—	2	2	6
TOTAL	1	6	2	—	9	9	18

South Wales and Monmouthshire.

Briton Ferry Works	1	—	—	—	1	1	1
Guest Keen Iron & Steel: Cardiff	1	2	—	—	3	3	4
Thomas, R., & Baldwins: Ebbw Vale	—	2	—	—	2	2	3
Steel Company of Wales: Margam	—	3	—	—	3	2.7	3
TOTAL	2	7	—	—	9	8.7	11

Apprentice Claims Damages

Suing by his mother, Gerald Martin (20), Johnson Avenue, Rugby, claimed against the British Thomson - Houston Company, Limited, for damages not exceeding £100 for an injury received when an oil guard fell on his foot at the works on June 23 last year.

Mr. I. Sutherland, for the plaintiff, said the claim arose out of the alleged negligence of a fellow workman at a bench at which Martin was working as an apprentice fitter. His colleague—a Mr. Johnson—placed against the bench an oil guard weighing some 30 lb. standing on its edge with a part protruding in front of the bench. Another workman—a Mr. Jones—knocked the guard over so that it fell on the plaintiff's foot. Special damages were agreed at £2.

The plaintiff gave evidence that the guard had been fitted by Johnson and was awaiting inspection. It was contended that the guard could have been placed flat on the floor out of the way.

After the plaintiff had given evidence, Judge Hamilton intimated that the case seemed a trivial one and suggested that an arrangement might be made. Counsel and solicitors then conferred, after which it was announced that the defendant company had offered £15 in full satisfaction, and this the plaintiff agreed to accept. Entering judgment by consent, the judge commended the parties on their "very sensible settlement."

High Rate of Employment

Details issued by the Ministry of Labour and National Service show that at the end of August there were 22,621,000 persons in civil employment covering industry, commerce, and services of all kinds. This was 103,000 more than in July and 252,000 more than in August, 1953. The number of persons registered as unemployed on September 13 was 236,000, of whom 9,000 were temporarily stopped. This total shows an increase of 3,600 when compared with those unemployed on August 9. Unemployment in September was 1.1 per cent. of the estimated total number of employees, the same proportion as in August, compared with 1.4 per cent. in September, 1953.

British Blast Furnaces in the September Quarter, 1954—*continued*

Staffordshire, Shropshire, Worcestershire, and Warwickshire.

Name of firm.	In blast at end of the third quarter, 1954.					Weekly average in blast.	Total existing at end of quarter
	Hematite.	Basic.	Foundry and forge.	Ferro-alloys.	Total.		
Goldendale Iron	—	—	1	—	1	1	2
Lilleshall	—	—	1	—	1	1	2
Round Oak Steel Works	—	—	—	—	—	0.6	2
Shelton Iron, Steel & Coal	—	3	—	—	3	3	3
Stewarts and Lloyds: Bilston	—	3	—	—	3	3	3
TOTAL	—	6	2	—	8	8.6	12
Sheffield.							
Park Gate Iron & Steel	—	2	—	—	2	2	2
GRAND TOTAL	13	56	20	4	93	95.9	139

Weekly Average Number of Furnaces in Blast during the September Quarter, 1954, and the Previous Four Quarters

District.	1953.			1954.	
	Sept.	Dec.	March.	June.	Sept.
Derby, Leics., Notts., Northants, and Essex	26.5	26.9	26.2	25.8	24.2
Lancs. (excl. N.-W. Coast), Denbigh, Flint, and Ches.	6	5.9	6	6	4.2
Lincolnshire	12.6	12	11.2	10.3	9.3
North-East Coast	24	24.7	25	25	22.9
Scotland	9	9	9	9.1	9
Staffs., Shrops., Worcs., and Warwicks.	8.9	9	9	8.5	8.6
S. Wales and Monmouth	7.6	9	8.9	9	8.7
Sheffield	2	2	2	2	2
North-West Coast	8	8	8	7.5	7
TOTAL	104.6	106.5	105.3	103.2	95.9

The following companies have furnaces in course of construction or rebuilding:—Darwen & Mostyn Iron; John Summers; Stewarts and Lloyds (Bilston); Dorman, Long & Co. (3); Lancashire Steel Corporation; South Durham Steel & Iron (West Hartlepool and Cargo Fleet); Steel Co. of Wales.

Making Money

One unassailable monopoly in this country is the minting of coin by the Royal Mint. Indeed, the report of the Deputy Master and Comptroller for 1952, issued last month, shows that only two cases of the crime of coining were reported in that year and then the value of the counterfeit coins was only £318. Altogether in 1952 the Mint struck 488,750,869 coins, but 91 per cent. of the entire production went for export. Only 45,377,583 were for U.K. currency.

The previous year saw the suspension of the striking of cupro-nickel coin because of the shortage of nickel, and, apart from 1,000,000 sixpenny pieces for the West Indies, there are no cupro-nickel coins dated 1952. However, 2.500,000 were struck that year for release after the Coronation in 1953.

The effect of the nickel shortage was not felt in the United Kingdom, as white coinage in general was not scarce and the surplus of pence remained. About 30 per cent. by weight of the orders for overseas administrations, which offset the fall in U.K. demand, was for bronze coin containing no nickel and 25 per cent. was for nickel-brass coins requiring only 1 per cent. of nickel. The total weight of metal required in the year's activities was 4,880 tons.

AIR CONTROL INSTALLATIONS, LIMITED announce that Mr. A. W. Evans, at present Birmingham-area manager, has been appointed general sales manager at the head office at Ruislip. The Birmingham office will in future be managed by Mr. W. Lennon.

Board Changes

ASSOCIATED ENGINEERING HOLDINGS, LIMITED—Mr. Jack Lyndhurst Hepworth has been appointed a director.

BRITISH INSULATED CALLENDER'S CABLES, LIMITED—Mr. Douglas Taft Hollingsworth has been appointed a director.

FLEXIBLE DRIVES (GILMANS), LIMITED—Lt.-Col. D. W. R. Walker has joined the company as joint managing director.

I.C.I. LIMITED (NOBEL DIVISION)—Dr. W. J. Jenkins, chairman of the division, is to be succeeded by Dr. J. Craik as from April 1 next.

I.C.I. LIMITED (METALS DIVISION)—Dr. R. Beeching has been appointed chairman as from February 1 next in succession to Mr. C. E. Prosser.

BRUSH GROUP—Sir Harold Roxbee Cox has been elected a director. Until recently Sir Harold was Chief Scientist, Ministry of Fuel and Power.

MASSEY-HARRIS-FERGUSON, LIMITED—Mr. E. P. Taylor, Mr. W. E. Phillips, Mr. C. W. Webster, Mr. M. W. McCutcheon, and Mr. J. A. McDougald have been elected to the Board.

ROVER MOTOR COMPANY, LIMITED—Mr. E. Ransom Harrison, of Sheffield, the chairman, has resigned from the Board on account of ill-health. Mr. H. Howe Graham, deputy chairman, has been elected to take his place as chairman. Mr. Graham was elected to the Board in 1932 and became deputy chairman in 1952.

Foundry Trades' Equipment and Supplies Association

Annual Report

At the annual general meeting of the Foundry Trades' Equipment and Supplies Association held at the Wardorf Hotel, London, on October 28, the following report of the year's activities up to December 31, 1953, was presented:—

Membership

One new member has been admitted during the year and the number of members of the Association on December 31, 1953, was 66. This number is an all-time record, and the Council is of the opinion that the prestige of the Association has never been higher since its inception over nineteen years ago.*

Accounts

The accounts for the year ended December 31, 1953, showed a surplus of £46 9s. 1d. making a balance of £79 17s. 4d. to be carried forward.

Council

During 1953 the Council held eight meetings and numerous matters which received attention have been published in circulars to all members of the Association.

Circulars

In addition to trade enquiries received by the Association, the details of which have been referred to interested members, circulars containing details of events and other matters relating to the industry, have been issued throughout the year.

Handbook

The handbook committee, under the chairmanship of Mr. W. Rawlinson, continued its work on the compilation of the second edition of the British Foundry Plant and Supplies Handbook, and over 3,000 copies have been distributed to foundries throughout the United Kingdom. Copies have also been sent to foreign journals, overseas embassies and trade fairs, and the balance of approximately 1,000 handbooks will be sent to overseas foundries in various countries.

The Council wishes to record its appreciation of the work carried out by the committee which has resulted in an excellent publication which will prove useful to potential buyers of foundry equipment and supplies.

Index of Foundries

For the purpose of distributing copies of the second edition of the British Foundry Plant and Supplies Handbook, a list of names and addresses of foundries in the United Kingdom was compiled by Mr. C. Orton Foster and Mr. W. E. Aske, who are thanked for their services in this connection. The Council considered that this list could be beneficially utilized by members of the Association and it was decided, therefore, that an index should be produced and made available to members. It was regretted that the Association was not in a position to finance the cost of producing the index and copies have, therefore, been sold—and are still available for sale—to members on request.

Exhibitions

The Association is maintaining its close co-operation with the organizers of the Engineering, Marine and Welding Exhibition which will incorporate a foundry section in 1955. Since the last annual general meeting, the Association has not participated in any exhibitions but members have exhibited individually in the Mechanical Handling Exhibition held at Olympia in June, 1954.

Ventilation Committee (Pedestal Grinders)

The work of this committee has continued under the chairmanship of Mr. G. E. Lunt and in conjunction with the British Steel Castings Research Association. Tests and observations have been carried out at the dust research station in Sheffield, with the result that members who manufacture pedestal grinders are now producing modified machines for use in foundries. The most important feature of the modifications is that they do not include any complicated innovations or alterations to the construction of the equipment and they can, therefore, be applied to existing machines. A report on the work will be published in due course from which it will be noted that every effort has been made to control the dust as near as possible to its origin.

Institute of British Foundrymen

Members of the Association jointly contributed £147 7s. 0d. to the 1953 conference fund of the Institute.

British Standards Institution

Representatives of the Association continue to serve on the technical committees of the Institution. A British Standard has now been issued for chilled-iron shot and grit, this publication having been prepared under the supervision of the B.S.I. Mechanical Engineering Industry Standards Committee, upon which this Association is represented.

General

The Council feel strongly that, in concluding their report, the efforts of those individuals serving as the Association's official representatives should be acknowledged with grateful thanks. The Association has once again had an active and successful year, and it is emphasized that members should use the facilities offered by the Association, which is in existence for the promotion of their interests.

The report is signed by F. Webster, president, and Peat, Marwick, Mitchell & Company, secretaries.

* * * * *

At the meeting, when the above report was presented, Mr. C. Orton Foster (British Foundry Units, Limited) was elected president.

* The Association was actually formed in 1926—Editor.

Modern Production of Whiteheart Malleable Iron*

Discussion of the Paper by J. Bernstein

When the above Paper was considered, it was perhaps a little unfortunate that simultaneously there was a session on cupola practice which proved very popular. However, it follows that the members participating in the discussion reported below were those keenly interested in Mr. Bernstein's subject matter. Pattern layout and methods of working; distortion of castings when gaseous annealed; foundry control and its implications; thick-section whiteheart and machinability were among the topics raised. The Author's replies emphasized that the degree and location of control systems imposed were "tailored" to suit his firm's applications of the processes quoted. Interesting comment arose on gaseous annealing vis à vis *other processes, particularly in regard to costs, control, and silicon content of the castings.*

Discussion of the above Paper at the annual conference, in Glasgow, of the Institute of British Foundrymen, was opened by MR. B. LEVY, whose questions mainly concerned pattern equipment. He asked whether the patterns illustrated were separate cope-and-drag plates. With regard to the statement that the pattern equipment used on the machines was primarily of brass and iron, he said he knew that the Author's firm had used aluminium patternplates a number of years ago and wondered whether they had found such disadvantages that they had gone over to bronze and cast-iron in consequence. He personally considered that the cast-iron patternplates were always the best from the points of view of economy and general functioning.

Coming to the illustrations of the couplers in Figs. 2 and 3, he was rather mystified as to how Mr. Bernstein retained the centres of the tube patterns on the plate in Fig. 2. In other words, how did he get the tube to come through the plate and still keep the centre of the plate there; when a ring was pushed through a plate there was a hole formed, and yet apparently the centre of the hole was kept there to act as a stripping plate.

Next, it was stated in the text above Fig. 4 that for sizes smaller than $\frac{1}{4}$ in., cores were necessary. Here Mr. Levy suggested that shell moulding might be a good method to adopt, because he had found that such small tubes could be dealt with by shell moulding, even without the use of stripping-plate methods.

Lastly, being interested in malleable castings for another purpose, he asked if distortion occurred by reason of the increased speed at which Mr. Bernstein was at present annealing his castings, and whether some distortion occurred with all shapes of castings. That is, was it a general occurrence with all castings, due to the mere process of annealing, irrespective of the section of the castings or whether or not they had lugs on them, and so forth?

MR. BERNSTEIN replied that his firm still used aluminium patternplates; but those to which Mr. Levy had referred were separate cope-and-drag plates. They did not use aluminium metal plates on any of their machines for malleable castings.

MR. LEVY said he supposed it had been found better to go over to the separate cope-and-drag.

MR. BERNSTEIN agreed and added that they now did very little snap-flask work.

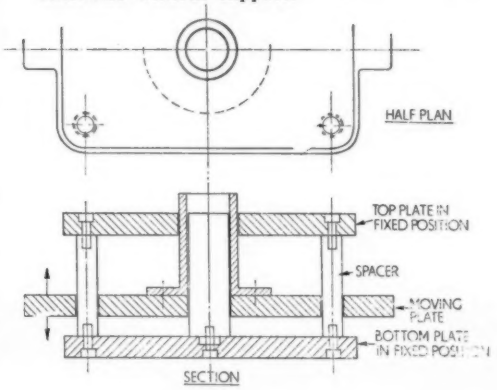
Stripping-plate Design

Coming to details of the stripping plate, he said it was difficult to describe, but if Mr. Levy could come along to the foundry to see him he could perhaps explain it properly.

MR. LEVY said that one might use three plates. At his own works they were making a special job on those lines and had had to utilize three layers. (Mr. Levy here illustrated his remarks by means of the sketch shown in Fig. A.)

[EDITOR'S NOTE.—When correcting his discussion contributions, Mr. Bernstein elaborated the description of this type of stripper plate, saying there were in effect three components. The top plate was of cast iron, with drilled holes, a centre plate carried the tubes, and the bottom

FIG. A.—*Method suggested by Mr. B. Levy of arranging three plates for a self-stripping plate, where the plate centre is a complete ring and otherwise without support.*



*Paper printed in the JOURNAL, August 12, 1954.

plate carried the centre pieces for the top plate. The top and bottom plates remained fixed while the centre plate was free to move up and down. It is clear, therefore, that this equipment is in fact of the type described by Mr. Levy.]

Distortion

MR. BERNSTEIN, dealing with distortion, said that it occurred, not on all castings, but on all types, and to a much less degree in some cases than others. It was very much the shape of the castings which determined the degree of distortion. He believed the real reason for the increased amount of distortion was that there was virtually no support; one could only support the castings one on top of another or with other castings. After some time in service the stools would sag and all the castings would tend to show distortion, following the shape of the plates on the stools. It was quite a problem, and it accounted for a fair proportion of the direct-labour costs.

MR. LEVY asked if the distortion factor was constant.

MR. BERNSTEIN replied in the negative, saying it varied very widely. His firm had not solved the problem of distortion, but they were able to reduce it by repeatedly levelling off the bogies and putting on fresh stools and fresh plates, and by improving techniques of packing. Another factor giving rise to increased distortion might well be that the temperature was higher, by approximately 100 deg. C., than could be expected in other forms of annealing.

Drawing attention to some samples he had brought to illustrate a particular surface defect, he said the finish was most peculiar, like velvet to the touch, and it was due to air leaks during cooling. There was a considerable amount of water-vapour in the atmosphere at annealing temperatures and, when this was cooled by the ingress of air, it tended to condense as water on to the castings, giving the peculiar effect mentioned.

As to the suggested application of shell moulding for sizes smaller than $\frac{3}{4}$ in., he said he did not really know if it would pay. His firm had considered shell moulding and had postponed a decision. The particular coremaker concerned with that class of work made the cores for the $\frac{5}{8}$-in. dia. job by hand and not by machine, and was able to produce 7,000 per day. So that the cost of the cores was not a very big factor in this case.

Wide Aspects of Control

MR. G. R. SHOTTON congratulated Mr. Bernstein on a very well constructed and instructive Paper, and complimented him in general terms on the high productivity achieved and on the obviously high degree of control attained. It was quite interesting to hear of the broad scope of his inspection service, and he had no doubt that that, in itself, effected savings by quickly bringing variables under control, which variables would otherwise continue for a longer period.

The Paper tended to give the general impression of the successful production of whiteheart castings up to 8-in. section. The Author had made a disclaimer in the concluding paragraph which clarified matters, but the opening paragraph and the references in the Paper gave rather a wrong impression. It was rather to be expected—and he had mentioned it—that most of those very exceptional castings would have some defect in the centre, and with a mottled casting and very little effective decarburization, Mr. Shotton did not think the Author could fairly claim that the material in the centre of the castings was absolutely to specification. On the other hand, he congratulated the Author on having produced a somewhat unusual material to meet a very special purpose.

In connection with the chemical analyses, Mr. Shotton said one could not substitute 0.1 per cent of carbon for 0.1 per cent. of silicon, and it might have improved the Paper from the record angle if the approximate proportion of carbon and silicon had been stated separately. Could Mr. Bernstein given a general picture of the relative proportions of carbon and silicon over his general ranges of castings?

MR. BERNSTEIN said his firm had found very definitely, when the question of reducing costs came up, that a primary necessity was to reduce scrap, and this was done by examining every rejected casting and analysing the defects. They had increased inspection as the very first means of finding the trouble, and the measure had more than paid for itself. The reduction of scrap by 2 per cent. over a month meant saving a very big sum of money. The current scrap was 33 per cent. of that formerly.

They had tried to encourage female operators to do the inspection as far as possible, and were training one female ex-moulder as an inspector. They had saved a little money by this means. Inspection at the knock-out stage was best done by an experienced moulder.

Heavy-section Whiteheart

On the question of the iron used, he questioned that it was whiteheart; he did not think it was, but he could say without exaggeration that all the heavy castings were being used successfully. Formerly these jobs had been of cast steel; a few had been made in a special type of grey cast-iron, but even that had insufficiently fine grain to give the degree of polish required. Certain steel castings used in the construction of their mechanized sand plants wore out very quickly and during the last few years they had changed over to the use of the peculiar type of whiteheart iron described, with a considerable saving in costs. He would not like to say that wear resistance was higher than when steel was used, but at the moment it would appear that it was at least as good and the castings were far cheaper. On the shotblast unit, the wear resistance of the new material was definitely better than that of the equivalent made in steel.

He quite agreed that one could not say that 0.1 per cent. of silicon was equivalent to 0.1 of carbon,

but he had tried to emphasize that he was referring specifically to the order of control which was applied. When running with a carbon content of 3.5 per cent. for a particular type of casting of a given section, it was safe to have 0.5 or 0.6 per cent. of silicon, as indicated in the Table I. As the section increased the silicon was decreased, and the carbon went down very slightly either because of the additions made to the ladle or it was deliberately reduced by addition of steel to the charge.

MR. SHOTTON said he could appreciate the point; they were using a control within specified limits.

MR. BERNSTEIN agreed; he said it was purely on their production unit that the figures given could be used, and emphasized that the system might not apply elsewhere. On this question of reducing the carbon and silicon contents by additions to the ladle or the furnace, and the occurrence of mottle in the thicker sections, he had stated in the Paper that for some reason there was less mottle if the steel were added to the ladle.

He would not like to leave members with the impression that quantities of castings up to 8-in. section were made, but he was able to cover a much wider range than was previously thought possible in whiteheart malleable

MR. SHOTTON said he was quite sure that a conventional blackheart material would not be so serviceable for this special-purpose job, as would the material Mr. Bernstein had described.

Machining Qualities

MR. R. E. NUTT, referring to the total-carbon variation of from 3.2 to 3.6 per cent. and varying silicon contents from 0.4 per cent. upwards, stated it had been his experience that it was impossible to anneal satisfactorily material with a silicon content below 0.55 per cent. That had been borne out by Hancock, who had given 0.55 per cent. as the minimum silicon content. He would like to know the temperature gradient in Mr. Bernstein's furnaces; in his own it was quite steep and this had considerable effect on the annealing results. He was surprised to learn that in the Author's plant the cupola slag-hole was open all the time, for it was difficult to maintain correct cupola control under such conditions. Finally, he wondered if there were difficulties in machining whiteheart malleable iron castings of 8-in. section.

MR. BERNSTEIN, dealing with the last point first, said the material machined extraordinarily well and the tool wear appeared to be low; in his opinion it was not so much that the actual frictional wear was lower, but the loss due to jamming and binding was reduced. He would be happy at any time to demonstrate the results quoted in the Paper.

On the point that the minimum silicon content of the material for satisfactory annealing should be 0.55 per cent., he said that in another field he had been called a rebel, and he was afraid he might have to accept the same charge again. He did not agree that 0.55 per cent. was the lowest silicon content at which satisfactory annealing could be carried out because at his foundry it was frequently lower than that; the furnace manufacturers and their technical representatives had seen material of lower silicon content than that annealed satisfactorily. The secret was the decarburizing atmosphere; it all depended on that and the section thickness. At his foundry they claimed that their technical control was rigid; it was rigid within a certain range, and he did not think they could reduce that range and still maintain the same order of control achieved. Similarly, if that control were relaxed they could not achieve the successful results currently obtained.

Furnace Details

With regard to the temperature gradient in the furnaces, his firm was perhaps fortunate in that it was gradual; but ample circulation ducts were deliberately provided to ensure that circulating gases tended to keep the atmosphere as regular as possible. The shape of the temperature-recorder-curves was indicative of the difference between the thermocouple readings and the actual state of the furnaces. During spheroidization, the furnace was switched off at 1,060 deg. C. and quenched down to 650 deg. C. on the recorders and then the shape the curve took was noted. If the hysteresis or recalescence was such that the temperature reached 760 deg. C. the power would not be switched on again, but if it fell below that temperature, the furnace was switched on again and brought back to that point. The pink-coloured castings, shown earlier, came from one end of the furnace and various shades of blue were found which indicated unsatisfactory atmosphere circulation or temperature gradients within the furnace.

Mr. Bernstein added that in his opinion electric annealing was a most expensive form, but among the advantages were cleanliness, the fact that female labour could be employed, that it was possible to take the material directly into the paint shop when necessary and that more control during annealing could be achieved. This tended to compensate the cost factor.

No difficulty was experienced in operating the cupolas with the slag-hole open. One of his first errors on joining the company was to have the slag-hole closed, for difficulties then arose in controlling the slag and its composition. Later, he came to rely on the long experience of the foreman and resorted to the open slag-hole.

MR. NUTT asked if Mr. Bernstein placed test bars at different spots in the annealing furnace, because he had found a variation of 60 deg.—a value which was accepted as being normal.

MR. BERNSTEIN replied that when annealing castings which required a pair of test-bars, these were placed on the top layer. On the second layer the packing was opened out to ensure that there was no variation in the top two tiers of castings. He did not know how much variation there was throughout the furnace but obviously there was some.

Silicon Content and Process Control

MR. H. G. HALL said that in the Paper there was little about which he could disagree, and offered

Modern Production of Whiteheart Malleable Iron —Discussion

congratulations on a Paper which added to the general knowledge on the subject and tended to offset the reputation which some whiteheart malleable had in some quarters. If whiteheart castings were bought from firms exercising a high degree of control, he felt that the customer could be assured of a good product.

Recalling the suggestion that a silicon content of 0.55 per cent. was reported as the minimum that could be used if electric-furnace annealing were to be satisfactory, he said that where there was not elaborate technical control that was probably true; but he reminded members that German manufacturers of whiteheart, one in particular, worked with a silicon content as low as 0.3 per cent. for some of the more special castings. They did this successfully, without experiencing much difficulty and without using one of the relatively expensive electric furnaces. He believed that annealing in a modern conventional oven could be done more cheaply than in electric furnaces—and Mr. Bernstein had been honest about his costs.

The spheroidization to which Mr. Bernstein had referred represented a very big step forward in the whiteheart-malleable industry. Certainly it gave a very much superior product, but to his knowledge there were occasionally some little difficulties. On the examination of many of the spheroidized malleable castings he had found that they were beautifully spheroidized in the centre, but towards the edge there was a layer in which cementite had been precipitated around the grain boundaries; outside that there was another layer where the carbide was in a slightly pearlitic form. He was particularly interested in the layer in which cementite had been precipitated, for it was a "headache" from the angle of machinability, and he invited Mr. Bernstein's comments.

MR. BERNSTEIN, referring to spheroidization, said there had appeared some structures which certain of his colleagues had said did not exist. He pointed to Fig. 13 in the Paper—a photomicrograph of the structure at the centre of a heavy casting—and said there was a "patchwork" structure there. He had found also just what Mr. Hall had described. There was a tendency to get a ferritic band, then what appeared to be pearlite with a fine band of cementite, a trend for more ferrite and then a spheroidized structure.

However, it was known how deeply the casting had to be machined, and all that was worried about in the case of castings which were to be machined was to ensure that there was a sufficient ferritic band before reaching the cementite, or so that the latter was only just about reached.

He and his colleagues had done a certain amount of experimental work, though it was not extensive, to try to get a perfectly uniform spheroidized structure right to the surface, but they could not do this satisfactorily. However, the higher the residual carbon content, the more chance there was of perfect spheroidization, and it enabled them to reduce considerably the soaking time if it was ensured that the residual carbon content was fairly high.

MR. NUTT said that when he had referred to a minimum silicon content of 0.55 per cent. as being necessary to ensure satisfactory annealing, he had had in mind gaseous annealing and not any other form. In the gaseous-annealing oven, the figure quoted was regarded as correct.

MR. HALL said he believed the Germans were annealing that same material in a gaseous furnace.

THE CHAIRMAN, Mr. E. Longden, in closing the meeting, said the discussion had been lively, informative and very useful; and Mr. Bernstein, in his replies, had met very well the points that were raised. On behalf of the meeting he thanked Mr. Bernstein for an excellent Paper and discussion.

South Wales Ports Trade

During the period from January 1 to October 10, trade handled at the South Wales ports of Cardiff, Swansea, Newport, Barry, Port Talbot, and Penarth amounted to 16,573,891 tons, an increase of 117,922 tons over the corresponding period of last year. Imports during the period decreased from 7,752,530 to 7,668,312 tons, but exports rose from 8,703,439 to 8,905,579 tons. Arrivals of iron ore from abroad showed an increase of from 2,010,400 to 2,140,668 tons. Pitwood and mining timber imports increased by 10,000 to 241,550 tons, but inwards cargoes of iron and steel goods, including scrap, dropped from 561,516 to 283,066 tons. Imports of foreign coal were 26,434 tons against nil.

Shipments of coal to foreign destinations improved from 2,840,161 to 3,073,963 tons, but coastwise cargoes declined from 2,458,617 to 2,283,459 tons. Patent fuel sent oversea totalled 93,483 tons, against 86,821 tons, while home shipments, at 78,399 tons, compared with 86,821 tons. Tinplate shipments reached 207,561 tons, against 184,707 tons, and exports of iron and steel goods rose from 234,785 tons to 295,927 tons.

Pollution of River Derwent

The summons by the defendants, the Consett Iron Company, Limited, to strike out the action brought by Mrs. Laline Marguerite Lucie Martell and the trustees of the Derwent Angling Association for the alleged pollution by the defendants' effluent of certain stretches of the River Derwent was dismissed by Mr. Justice Danckwerts in the High Court of Justice last month, when he held that the action was not being illegally maintained and was not an abuse of the process of the court.

Reading his judgment, Mr. Justice Danckwerts said that it would be disingenuous to disregard the difficulties which the man of small financial resources (not confined to the legal-aid class) faced in present-day conditions in defending such rights as he might have against infringement by powerful commercial corporations or adversaries who might draw their strength from the rates or the national exchequer. If such a man might not avail himself of the help of sympathizers his condition might be serious indeed. His relative position was still more unfavourable if his powerful commercial opponents might deduct the cost of such litigation as trade expenses.

Qualcast Staff Changes

Mr. Maurice Wardle has been appointed a trainee director of Qualcast, Limited, under the scheme introduced by the company in 1949 to train young men for executive positions. At the moment there are seven trainee directors. Mr. Wardle has been with the company for 17 years. He started as junior assistant to the foundry manager and is now general manager of the grey-iron foundry division.

Mr. C. W. Lockhart, who was previously assistant general manager, Die-cast and Steel Divisions at Qualcast, Limited, Derby, has been appointed works direccast, Limited, Derby, has been appointed works director at Qualcast (Swan Gardens), Limited, Wolverhampton. Mr. Lockhart was transferred to Derby in 1947 from Qualcast (Ealing Park), Limited, where his early training had been in the pattern department. Mr. A. J. Batterham has been appointed works director of Qualcast (Wolverhampton), Limited. Mr. Batterham, who joined Qualcast, Limited, as office boy in 1929, was progress manager from 1939 to 1946 when he was appointed production manager. Mr. C. A. Payne, chief metallurgist of Qualcast, Limited, has been promoted to the position of assistant general manager, Die-Cast and Steel Divisions. Mr. Payne joined Qualcast, Limited, as an assistant metallurgist in 1940, assuming control of the laboratory in 1941. Prior to this, he was with Clegg & Murray, Limited, after a short spell in the laboratory of the Royal Naval Dockyard, Portsmouth. Still earlier, he was with Qualcast (Ealing Park), Limited. Mr. Payne is a past-president (1950) of the East Midlands branch of the Institute of British Foundrymen.

In an avuncular message to young employees, Mr. V. Jobson, the chairman, in announcing Mr. Wardle's appointment, said " Don't forget that we all get older at the same rate, and the men in responsible positions need assistants, because it is bad business policy to promote executives to more responsible jobs if they haven't a 'cover' who can do the job as well as they can. I want you all to know that is why, in Qualcast, every executive is always on the look-out for young men worth training for better jobs."

J.I.C. Elections

At its meeting on October 19, the Joint Iron Council executive committee, elected Mr. N. P. Newman, J.P., chairman and managing director of Newman, Hender and Company, Limited, Woodchester, Stroud, Glos., to succeed Sir Frederick Scopes as president for the year 1954-55. Mr. S. W. Martin, acting chairman and managing director of the Staveley Iron and Chemical Company, Limited, Chesterfield, was elected vice-president in place of Mr. Newman, who succeeds Sir Frederick Scopes.

Sir Frederick Scopes is managing director of the Stanton Ironworks Company, Limited, Nottingham, and one of the managing directors of Stewarts and Lloyds, Limited. He has been president of the Joint Iron Council since 1948, and was knighted in the Birthday Honours List this year. Sir Frederick remains a member of the executive committee of the Joint Iron Council, and becomes chairman of the Council's finance committee in succession to Mr. S. H. Russell, a director of S. H. Russell and Sons, Limited, Leicester, who is president-elect of the British Cast Iron Research Association. Mr. Russell will retain his membership of the Joint Iron Council finance committee.

EIGHTY FOREMEN have enrolled for a new course at Stafford County Technical College, which will consist of seven lectures.

Foot Safety

In connection with the National Industrial Foot Safety Week, an exhibition was opened in Birmingham on October 25 at the Industrial Safety Training Centre, demonstrating examples of industrial footwear and illustrating some of the kinds of accidents that occur to the feet of workers not using protective wear. Mr. R. Bramley Harker, Chief Superintendent of Factory Inspectors, South Midland Division, said that in the division alone in one year, there were 9,884 accidents in the 11,735 factories and 1,667 of them were foot accidents. In his view, 1,072 of those foot accidents could have been prevented. In Birmingham and Coventry areas, he thought a higher proportion of foot accidents could be prevented by wearing safety footwear than in any other part of the country. Mr. Harker appealed to employers to organize schemes whereby workers could obtain safety footwear at their works (such as have already been arranged for ironfoundry workers).

Of 467 accidents in Sheffield works during two months, 94 resulted in injured feet. Fifty were avoidable, or the injuries would have been less severe, if safety footwear had been used. A factory inspector carried out the survey on which these figures are based for the Sheffield Area Industrial Group of the Royal Society for the Prevention of Accidents. The survey states that 800 of the 4,000 works accidents a year in Sheffield are foot accidents, and suggests that the number could be reduced to 600 by attention to foot safety and " things that drop." The group has organized a foot-safety week in local factories.

Post-conference Postscript

Many of the visitors to the Florence International Foundry Conference included a visit to Rome in their post-congress tour. Two British foundrymen, Mr. L. H. Crump and Mr. A. R. Wizard, through the auspices of Commendatore Olivo, were accorded, with other foundrymen of diverse nationalities, an audience with the Pope at his residence at Castelgandolfo. His Holiness spoke for 20 minutes on the good work the industry had rendered to the world and reminded them of their responsibilities towards their workpeople. Later in the day, the visitors were received by the Mayor of Rome, prior to being escorted round the magnificent art collection of the city.

The two English representatives visited many wonderful buildings, art collections and the Catacombs. After a few days in Venice this tour ended in Milan with a visit to an art foundry which is probably one of the finest of its kind in Europe.

R.S.A. Awards

The Royal Society of Arts offered this year a prize of £20 under the Fothergill Trust for an essay or model embodying some new idea for the prevention or suppression of fire. On the advice of the judge, Mr. S. H. Clarke, M.SC., Director of the Fire Research Station, D.S.I.R., the Council have divided the prize as follows: £10 to Mr. H. G. Bayliss, of Weymouth, for his essay on the inculcation of fire-consciousness in children; £5 to Mr. P. M. Pucill, of Chiswick, for a description of a warning device for the prevention of crankcase explosions in motor ships; and £5 to Mr. A. R. Broomfield, of Northampton, for a scheme for connecting a sprinkler alarm system direct to a fire station. The Council were unable to award the Benjamin Shaw Prize for industrial safety and the Howard Prize for mechanical motive power, each of £20, which were offered at the same time.

News in Brief

AMONG RECENT CONTRACTS obtained by Millspaugh, Limited, manufacturers of papermaking machinery, of Sheffield, is a dollar order for a Canadian mill worth nearly £300,000.

THE LEIPZIG SPRING FAIR—mainly for technical exhibits—will be held from February 27 until March 9, 1955. From September 4 to 9 there will be an Autumn Fair to cover consumer goods.

THE REPORT of the Royal National Institute for the Blind shows that in 1953-54 291 placements and 100 replacements of trained blind men and women were made in industry and commerce, creating a new record for one year.

THE HEAD OFFICE of Eimco (Great Britain), Limited, manufacturers of mechanical shovels and filtration plant, of Leeds, will be located at Team Valley, Gateshead-on-Tyne, 11 (telephone: Low Fell 7-7241), from November 15.

KODAK LIMITED announce the marketing of the Universal Safelight lamp model 2 and "Kodapan" Safelight lamp model 2 which, while retaining the qualities of their predecessors, are at the same time stronger in construction.

THE AMERICAN EXCHANGE PAPER to the Institute of British Foundrymen, to be presented at the International Congress to be held in London next June is to be given by Mr. H. Brown, chief metallurgist, Solar Aircraft Company, Des Moines, Iowa.

THE BRITISH ALUMINIUM COMPANY, LIMITED, announce that Mr. P. Ralph has been appointed manager of the Scottish branch sales office in succession to Mr. M. J. J. Richards who has been appointed assistant manager of London branch sales office.

A FURTHER £10,000,000 is to be spent by the Esso Petroleum Company, Limited, over the next few years on the development of its refinery at Fawley, near Southampton. Expenditure has already reached £35,000,000 since the plant was opened three years ago.

AFTER THE DISTRIBUTION OF PRIZES at a dinner held by the William Cook & Sons (Sheffield), Limited, angling society Mr. Andrew McTurk Cook, managing director, presented a cheque to Mr. Albert Frederick Shepherd to mark 50 years of continuous service with the company.

MR. J. JONATHAN, of Cox & Danks, Limited, the Oldbury scrap metal company, who is shortly retiring, has handed over the chairmanship of the Midland Regional Industrial Salvage and Recovery Council to his successor, Mr. F. R. B. Whitehouse, chairman of the Chad Valley group of companies. Mr. Whitehouse appealed to all manufacturers to join the movement, which is non-profit making.

MR. W. H. MCFADZEAN, C.A., chairman of British Insulated Callender's Cables, Limited, left by the Queen Elizabeth on October 21 for New York. While in North America he will visit Canada in connection with B.I.C.C.'s important interests there which include Philips Electrical Company (1953), Limited, of which Mr. McFadzean is chairman. He hopes to return to this country in early November.

THE MIDLAND INDUSTRIAL FILM ASSOCIATION, the first of its kind in the country, will be inaugurated on October 28 in Birmingham with addresses by Sir Arthur Elton, chairman of the Scientific Film Association and Mr. A. G. B. Owen, chairman of the Rubery Owen group. The aims of the Association are to view films in industry, encourage their effective use and discuss their production and technique.

RUMOURS that the control of L. Sterne & Company, Limited, the big Glasgow refrigerating manufacturers, is to pass into American hands, have been denied by an official of the company. He explained that his company were at present associated with the Tecumseh refrigerator company of America on the production of hermetically-sealed refrigeration units. The firm are trying to have the Tecumseh Company to take a financial, but not controlling, interest.

MR. L. LE COUTEUR, Deputy Chief Inspector of Factories, speaking in Scotland, said the British were not generally amenable to discipline, even though that discipline might be for their good. The initial reluctance of motor-cyclists to wear safety helmets was a case in point, and similarly in industry the enforcement of wearing safety boots, hard hats, goggles, etc., was often difficult and could only be achieved satisfactorily by gradually convincing the person concerned that it was for his own benefit.

TOO MANY FLOWERS around machinery are "cluttering up" the British Industries Fair at Castle Bromwich, the Purchasing Officers' Association has complained, raising the matter at a Birmingham meeting with Mr. R. P. S. Bache, one of the Fair's directors. In future, therefore, B.I.F. organizers are considering asking exhibitors to cut down on the displays of flowers they arrange on their stands. The reason for the meeting was to exchange ideas on how to make the 1955 Fair more attractive to home and overseas buyers.

THREE DIRECTORS of a Birmingham firm of brassfounders (Evered & Company, Limited, Surrey Works, Smethwick), who have all completed 60 years with the firm, intend to keep on working. The three directors, guests at a celebration dinner in Birmingham, are Mr. G. E. Gamble (aged 80), of Wylde Green, who attends the office every day; Mr. E. T. Miller (aged 75), who for 50 years has been the firm's representative in Australia, and Mr. H. G. Williamson (aged 75), of Bournemouth, the firm's south-of-England representative.

SIR RICHARD SNEDDEN, chairman of the Industrial Relations Committee of the British Employers' Confederation and general manager of the Shipping Federation, appealed to all industry and employers to support collective bargaining wherever it was possible when he spoke in Birmingham on October 26 at the annual luncheon of the Midland Monotype Users' Association. "British industry seems to be facing a wave of irresponsibility," he said, adding that responsibility was the basis of the system of collective industrial bargaining.

ON OCTOBER 1, Battelle Institute, Columbus (Ohio), completed its 25th year of service. Founded to conduct research on a non-profit-making basis, the Institute began operations in 1929 just as the great industrial boom of the late 'twenties was coming to an end. The staff, originally thirty, now numbers over 2,600. To-day the Institute is known and respected throughout the world of research and engineering. The 25th anniversary has a significance important to Battelle, as during this year the European laboratories at Frankfort and Geneva have come into full operation for the benefit of European industries.

DESPITE FEARS expressed at a meeting of the Aldridge Urban District Council on October 27 that if Castings, Limited, of Walsall, were allowed to occupy a site on the Leighswood Industrial estate there might be complaints from the public at a later date, the decision of the planning committee to permit the move, subject to certain conditions, was approved. The report

contained a resolution that the firm should be granted a site at the price of £10,000 subject to restrictive covenants designed to ensure that among other things, the company adopted "the best current practicable means of avoiding nuisance by reason of smoke, fumes or smell."

THE BAGHDAD FAIR which King Feisal of Iraq opened, is attracting attendances "far greater than had been expected," Mr. S. W. Gregory-Meakin, Midland regional secretary of the Federation of British Industries, said on October 28. The Fair has been organized by the Federation and at the opening ceremony, the B.S.A. Company, Limited, presented two of its products, a cycle and a gun, to King Feisal. Rolls Royce have received an order at the Fair for 60 scout cars worth £25,000, and the Associated Commercial Vehicle Group an order for lorries valued at £20,000. Several other British manufacturers have received orders. The Fair remains open until November 7.

THE 1954 VISCOUNT NUFFIELD PAPER to the Institution of Production Engineers will be presented at the Royal Institution, London, on December 9 next, at 6.30 p.m. The speaker will be Major-General W. A. Lord, C.B., C.B.E., director of mechanical engineering at the War Office, who will take as his subject the importance of the application of modern production technology and management to the work of the Corps of the Royal Electrical and Mechanical Engineers. Admission will be by ticket only, which may be obtained, together with a preprint of the Paper, on application to the secretary of the Institution of Production Engineers, at 10, Chesterfield Street, London, W.1.

A SETTLEMENT was announced in the Northern Ireland High Court last week of an action brought by Robert Lees (71), iron moulder, for damages for personal injuries. The defendants were Ritchie Hart & Company, Limited, iron founders and engineers, Mountpottinger Road, Belfast. Plaintiff sustained two injuries whilst in the employment of the defendants, and his Counsel told the Court that he must inevitably spend the remainder of his life burdened with a weeping left eye the consequence of molten metal striking it. The second accident in the foundry involved his right foot. The parties came to agreement in the Court by which Robert Lees, the plaintiff, will receive £250.

FOR THE VISIT of Her Majesty the Queen on October 27 to the River Don Works of English Steel Corporation, Limited, arrangements were made for workers to "clock out" for two hours in order to see the Queen, with holiday rates of pay during absence. The time-table arranged for the Queen to arrive at the main entrance of the works in Brightside Lane, and a welcome to Her Majesty and the Duke by Lieutenant-General Sir Ronald Weeks, chairman of the company, and Mr. F. Pickford, managing director. The route went from the entrance hall to the Siemens melting department where two stages, encased with armour glass, had been specially erected for the Royal party to see steel melting in process, with the tapping of a 90-ton furnace.

OPPOSING VIEWS on techniques of industrial safety were outlined by Mr. Norman Hare, a member of the team that produced the recent Industrial Engineering Productivity Report when he compared the British and American practice in an address to the Birmingham branch of the Institution of Works Managers on October 26. In Britain, he said, the law prescribed that guards should be used. The experience of the team was that, in America, the use of guards was found to be limited. Periodically, talks were given to groups of workers on the need for safety consciousness, each operator signing a book at the end of the talk. It was the belief of many American managements that to fit safety devices would mean loss of production and consequent increase in costs.

MR. C. H. M. OWEN (general manager of Devonshire works), who was appointed a director of the Staveley Iron and Chemical Company, Limited, last year, re-lit the firm's No. 3 blast furnace in a traditional ceremony on October 29. The furnace was blown out on September 1 for re-lining and renovation, and Mr. Owen re-lit it with a torch touched off by hot slag from one of the three other blast furnaces, so that the production of iron continued unbroken. Watching the ceremony were Mr. S. W. Martin (acting chairman and managing director), Mr. S. N. Turner (deputy managing director), senior officials and many of the workmen, who by completing the job in 51 days, nearly broke a record for the furnace re-lining. "It was essentially a combined operation," said an official; nearly 900 tons of firebricks were used.

SHAW PROCESSES, LIMITED, of 25 Clyde Vale, Dartmouth, Road, Forest Hill, S.E.23, proprietors of a number of precision casting methods, have now extended their activities to Australia, in consequence of which a company to be called Shaw Processes (Australia) Pty., Limited, Victoria, Australia, in association with Vericast, Limited, of Victoria, has been formed. The directors are: Mr. Clifford Shaw, Mr. Noel Shaw, Col. Peter Chance (chairman) and Mr. Kenneth Spencer. The company will operate a pilot and demonstration plant for the Shaw Process of precision casting which has become widely used in the United Kingdom and on the Continent, and which will thus serve as a training point for the considerable number of licensees which it is expected will be found in Australasia.

W. CANNING & COMPANY, LIMITED, electro-plating and polishing plant and materials, have completed extensions at their new Sheffield premises, 1, South Parade, Shalesmoor, which they acquired in 1952. The premises, formerly a Methodist Chapel, have been adapted to a warehouse and showroom. The firm first opened a Sheffield office in Sycamore Street in 1923, specializing in equipment and material for electro-plating and polishing nickel, chrome, cadmium, copper, silver, brass, gold, zinc and tin. It is now hoped to make routine analysis available in Sheffield for many local manufacturers who are customers. This is at present carried out for customers all over the British Isles at the firm's research laboratories at the head office in Great Hampton Street, Birmingham. The firm dates back to 1785 when it owned drysalters shops. The electroplating interest began in 1880 with the late Mr. T. R. Canning and his brother, Sir Ernest Canning, the present chairman of the company.

THE CHANCELLOR of the Exchequer, Mr. R. A. Butler, has given an assurance to the Birmingham Chamber of Commerce that trade and commercial policy will be taken into account in any question of making sterling convertible. The Chamber, through its president, Mr. J. I. Yates, had pointed out that the inconvertibility of sterling had given a high degree of protection to British manufacturers in many overseas markets. If, to bring about convertibility meant a sacrifice of that protection, the experiment would be a matter of serious concern to the Chamber. In his reply, reported to the Chamber on October 25, Mr. Butler said that it had always been part of the Government's policy in relation to convertibility that finance and trade should go together. The Chamber could rest assured that the Government would not approach the question of convertibility of sterling from the angle of finance only and that matters of trade and commercial policy both of creditor and debtor countries would have to be examined and properly arranged beforehand.

Raw Material Markets

Iron and Steel

Although the number of furnaces in blast in the September quarter was only 95.9 (weekly average), against 104.6 in the same quarter of last year, weekly outputs of pig-iron for the period averaged 220,700 tons, against 207,400 tons. The reduced number of furnaces in commission was largely due to units being shut down for relining and repairs, while the increased outputs were obtained from the new units which have been built and the reconstruction of plant. Several furnaces are now in course of construction or rebuilding, and when these are brought into operation, together with those which are now being relined or repaired, an appreciable increase in pig-iron production can be expected.

Raw materials are available at the furnaces to meet current consumption requirements. Supplies of ore are at a high level and future needs appear to be assured. Coke supplies, although they have so far been sufficient to burden the furnaces in production, are not so assured, and some fears are expressed that any appreciable increase in consumption may result in some difficulty in supply, while quality and size also cause some concern.

The higher production of basic steel making pig iron which is expected later will be readily absorbed by the steelworks. So far as the foundries are concerned, the only grade of pig-iron used by them which is in adequate supply is high-phosphorus iron for the light, jobbing, and textile foundries. Demands for this grade of pig-iron vary, because of the fluctuating demand for light castings. The foundries appear to be content to order just sufficient supplies to cover current consumption requirements, in spite of the prospect of an increase in prices.

On the other hand, the engineering and speciality foundries, which are very busy, are tied down in production by the scarcity of the low- and medium-phosphorus irons. Outputs are below demands and there is little prospect of an improvement in the supply. Some brands of hematite are also scarce, particularly in the higher silicon ranges. The call for refined iron has shown some increase recently, but makers appear to be able to meet the larger demands without difficulty.

Foundry and furnace cokes are coming forward fairly satisfactory. Supplies of scrap are meeting current consumption needs, although there is still a good demand for cast-iron machinery and heavy scrap.

Ganister, limestone, and firebricks are received to requirements.

In the negotiation of both home and export sales of finished steel products delivery dates have become the decisive factor. There is still plenty of business on offer, but, with four exceptions, makers are unable to handle any more orders before the end of the year. Only steel sheets are now subject to export licensing control, and home requirements are so heavy that it is feared that much profitable overseas trade may have to be turned down. This point can only be determined when the quotas for the first half of next year are disclosed. Pressure for heavy-steel plates has eased considerably, but the demand for the more popular sizes of joists has become most insistent and waiting lists are extending. Business in small bars and light sections is also much more active, but export sales are not attractive.

Non-ferrous Metals

The copper market developed considerable strength last week; cash gained £15 and three months £8, the backwardation widening from £15 to £22. There is certainly a serious shortage of copper at present, largely due to the prolonged dock strike, and this situation, it is to be feared, will persist for a long time, despite a return to work at the docks. It will be a long time before shipping schedules are straightened out and copper moves to the United Kingdom in a regular flow. The non-ferrous trade has been as hard hit as any by the dispute, for, apart from Government-held material, there are no stocks of any size available.

Probably, the wire-bar supply situation is as bad as any, but it is believed that there is also a serious shortage of blister which it will take time to put right. London Metal Exchange stocks are low and the chance of any improvement in this direction seems remote and the premium for the cash position can be expected to be maintained. Very little business was done in cash last week, but there was moderate activity in forward metal.

Tin continued to present a steady front, but cash lost £3 10s. and three months £3. Demand is fairly good, although world production is at a heavy rate. Zinc was rather weak, but closed somewhat above the worst at £81 5s. for both positions, which showed a loss of 25s. in prompt and of 10s. forward. Lead closed below the best touched during the week, but, nevertheless, £1 15s. better for October and £1 5s. up for January. Some slowing down in activity has occurred in certain directions. Business in scrap has been moderately good and it is reported that a modest tonnage of American material has been sold on this side.

Official metal prices were as follow:—

COPPER, Standard—*Cash:* October 28, £282 to £282 10s.; October 29, £280 to £285; November 1, £275 to £280; November 2, £277 10s. to £280; November 3, £277 10s. to £278.

Three Months: October 28, £260 10s. to £261; October 29, £262 to £263; November 1, £258 to £259; November 2, £260 10s. to £261; November 3, £260 10s. to £261.

TIN, Standard—*Cash:* October 28, £729 10s. to £730; October 29, £730 to £730 10s.; November 1, £727 10s. to £728; November 2, £730 to £731; November 3, £729 to £730.

Three Months: October 28, £729 10s. to £730; October 29, £728 10s. to £729 10s.; November 1, £727 10s. to £728; November 2, £727 10s. to £728; November 3, £726 10s. to £727.

ZINC—*Second half October:* October 28, £80 15s. to £81; October 29, £81 to £81 5s. *First half November:* November 1, £80 15s. to £81; November 2, £81 5s. to £81 7s. 6d.; November 3, £81 to £81 5s.

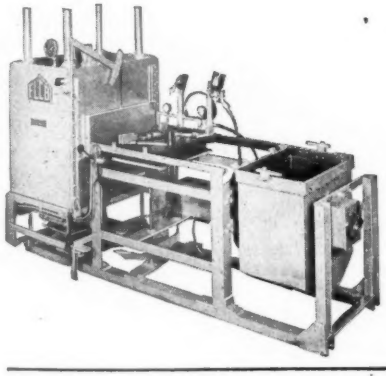
Second half January: October 28, £80 10s. to £80 15s.; October 29, £81 to £81 5s. *First half February:* November 1, £80 15s. to £81; November 2, £81 to £81 5s.; November 3, £81 to £81 5s.

LEAD—*Second half October:* October 28, £109 10s. to £110; October 29, £109 10s. to £110. *First half November:* November 1, £106 10s. to £106 15s.; November 2, £107 10s. to £108; November 3, £107 10s. to £108 10s.

Second half January: October 28, £102 15s. to £103 5s.; October 29, £103 to £103 5s. *First half February:* November 1, £101 15s. to £102; November 2, £102 10s. to £102 15s.; November 3, £103 5s. to £103 10s.

SHELL MOULDING AT LOW COST

The Shelmolda 'Duplus' is low in first cost, economical to operate and costs little to maintain. Its design is simple and straightforward, yet it has the advantages of more complicated and costly apparatus. Operation is semi-automatic, with all the strenuous work carried out mechanically. The patent oven is thermostatically controlled and gives the machine a proved capacity of 50/60 moulds per hour. Pattern plates measure 24in. by 16in. and the maximum depth of pattern is 5in. Floor space required is 8ft. 6in. by 3ft. 3in. and the machine is operated by one man. Cost of the Shelmolda 'Duplus' is £575; delivery is 8 to 10 weeks.



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DUPLUS

PATENT APPLIED FOR

FAIRBAIRN LAWSON COMBE BARBOUR LTD

LEEDS, ENGLAND. Telephone : Leeds 32041

236/73

Current Prices of Iron, Steel, and Non-ferrous Metals

(Delivered unless otherwise stated)

November 3, 1954

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2:—Middlesbrough, £14 19s. 6d.; Birmingham, £14 12s. 9d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £17 5s. 9d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. Si), d/d within 60 miles of Stafford, £17 16s. 9d.

Scotch Iron.—No. 3 foundry, £17 9s. 6d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £18 19s. 6d.; South Zone, £19 2s. 0d.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £19 19s. 6d.; South Zone, £20 2s. 0d.

Hematite.—Si up to 2 per cent., S. & P. over 0.03 to 0.05 per cent.:—N.-E. of England (local iron), £17 14s. 6d.; Scotland (Scotch iron), £18 1s. 0d.; Sheffield, £18 19s. 0d.; Birmingham, £19 6s. 6d.; Wales (Welsh iron), £18 1s. 0d.

Basic Pig-iron.—£15 10s. 6d. all districts.

FERRO-ALLOYS

(Per ton unless otherwise stated, delivered)

Ferro-silicon (6-ton lots).—40/55 per cent., £42 0s. 0d., basis 45 per cent. Si, scale 17s. per unit; 70/84 per cent., £65 0s. 0d., basis 75 per cent. Si, scale 18s. per unit.

Ferro-vanadium.—50/60 per cent., 23s. 8d. to 25s. 0d. per lb. of V.

Ferro-molybdenum.—65/75 per cent., carbon-free, 10s. 0d. per lb. of Mo.

Ferro-titanium.—20/25 per cent., carbon-free, £185 0s. 0d. to £195 0s. 0d. per ton; 38/40 per cent., £251 0s. 0d. to £270 0s. 0d. per ton.

Ferro-tungsten.—80/85 per cent., 14s. 0d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 17s. 0d. per lb. of W.

Ferro-chrome (6-ton lots).—4/6 per cent. C, £75 0s. 0d. to £80 0s. 0d., basis 60 per cent. Cr, scale 25s. 0d. per unit; over 6 per cent. C, £74 0s. 0d. to £76 0s. 0d., basis 60 per cent. Cr, scale 24s. 0d. per unit; 2 per cent. C,* 1s. 7½d. per lb. Cr; 1 per cent. C,* 1s. 8d. per lb. Cr; 0.15 per cent. C,* 1s. 9½d. per lb. Cr; 0.10 per cent. C,* 1s. 9¾d. per lb. Cr; 0.06 per cent. C,* 1s. 10d. per lb. Cr.

Metallic Chromium.—98/99 per cent., 6s. 6½d. to 7s. 1d. per lb.

Metallic Manganese.—93/95 per cent., carbon-free, £225 0s. 0d. to £232 0s. 0d. per ton; 96/98 per cent., £255 0s. 0d. to £262 0s. 0d. per ton.

Ferro-columbium.—60/75 per cent., Nb + Ta, 52s. 6d. to 70s. 0d. per lb., Nb + Ta.

Ferro-manganese (home).—78 per cent., £54 15s. 0d.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—BASIC: Soft, u.t., £25 12s. 6d.; tested, 0.08 to 0.25 per cent. C, £26 12s. 6d.; hard (0.41 to 0.60 per cent. C), £28 0s. 0d.; silico-manganese, £33 16s. 0d.; free-cutting, £28 16s. 6d. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £32 12s. 0d.; silico-manganese, £34 17s. 6d.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £29 16s. 0d.; basic, hard, over 0.41 up to 0.60 per cent. C, £30 16s. 0d.; acid, up to 0.25 per cent. C, £33 0s. 0d.

FINISHED STEEL

Heavy Plates and Sections.—Ship plates (N.-E. Coast), £31 1s. 6d.; boiler plates (N.-E. Coast), £32 9s. 0d.; floor plates (N.-E. Coast), £32 10s. 6d.; sectional material, N.-E. Coast, £29 4s. 6d.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., untested, £32 7s. 0d.; flats, 5 in. wide and under, £32 7s. 0d.; hoop and strip, £33 9s. 0d.; black sheets, 17/20 g., £42 1s. 0d.; galvanized corrugated sheets, 24 g., £51 8s. 6d.

Alloy Steel Bars.—1 in. dia. and up: Nickel, £53 8s. 0d.; nickel-chrome, £75 2s. 0d.; nickel-chrome-molybdenum, £84 13s. 6d.

NON-FERROUS METALS

Copper.—Cash, £277 10s. 0d. to £278 0s. 0d.; three months, £260 10s. 0d. to £261 0s. 0d.; settlement, £278 0s. 0d.

Copper Tubes, etc.—Solid-drawn tubes, 32⅝d. per lb.; wire, 316s. 6d. per cwt. basis; 20 s.w.g., 347s. 9d. per cwt.

Tin.—Cash, £729 0s. 0d. to £730 0s. 0d.; three months, £726 10s. 0d. to £727 0s. 0d.; settlement, £730 0s. 0d.

Zinc.—First half November, £81 0s. 0d. to £81 5s. 0d. first half February, £81 0s. 0d. to £81 5s. 0d.

Zinc Sheets, etc.—Sheets, 15 g. and thicker, all English destinations, £111 5s. 0d.; rolled zinc (boiler plates), all English destinations, £109 0s. 0d.; zinc oxide (Red Seal), d/d buyers' premises, £96 0s. 0d.

Lead (Refined Pig).—First half November, £107 10s. 0d. to £108 10s. 0d.; first half February, £103 5s. 0d. to £103 10s. 0d.

Brass Tubes, etc.—Solid-drawn tubes, 26½d. per lb.; rods, drawn, 35½d.; sheets to 10 w.g., 288s. 6d. per cwt.; wire, 33½d.; rolled metal, 274s. 6d. per cwt.

Brass (Brazing).—BS1400, B3 (65/35), £190; B6 (85/15), £238; BS249, £200.

Brass (High Tensile).—BS1400, HTB1 (30 tons), £219; HTB2 (30 tons), £230; HTB3 (48 tons), £240.

Gunmetal.—RCH, 3/4 per cent. tin, — ; BS1400, LG2 (85/5/5/5), £236 ; LG3 (86/7/5/2), £246 ; G1 (88/10/2/½), £316; (88/10/2/1), £305.

Phosphor Bronze.—BS1400, PB1 (AID released), £330 per ton.

Phosphor Bronze Strip, etc.—Strip, 407s. 3d. per cwt.; sheets to 10 w.g., 429s. 9d. per cwt.; wire, 50½d. per lb.; rods, 44½d.; tubes, 42½d.; chill cast bars: solids 44d., cored 45d. (CHARLES CLIFFORD, LIMITED.)

Nickel Silver, etc.—Rolled metal, 3 in. to 9 in. wide × 0.056, 3s. 5d. per lb.; round wire, 10g. in coils (10 per cent.), 3s. 10½d.; special quality turning rod, 10 per cent., ½ in. dia., in straight lengths, 3s. 9½d. All prices are net.

Other Metals.—Magnesium, ingots, 2s. 3d. per lb. Antimony, English, 99 per cent., £210 0s. 0d. Quicksilver, ex-warehouse, £110 0s. 0d. to £111 0s. 0d. Nickel, £483 0s. 0d. Aluminium, ingots, £156 0s. 0d.; aluminium bronze (BS1400), AB1, £285 ; AB2, £290. Solder, brazing, BS1845, 2s. 3 d. lb.; granulated. 2s. 6d. lb.

* Average 68-70 per cent. Cr.